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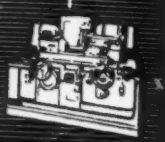

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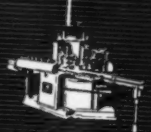

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THE TABULAR VIEW

Sensation. — The contributions which taste, smell, and the cutaneous sensations make to man's perception and interpretation of his environment are ably presented (page 87) in the concluding section of a two-part article by FREDERIC W. NORDSIEK, '31. A wealth of experience in biology, public health, and the food industry has been combined with a flair for writing in Mr. Nordsiek's latest study for The Review. Mr. Nordsiek holds a patent on a dairy product, is contributor to the *Encyclopedia Americana* as well as to several periodicals, and since 1943 has been assistant to the director, Research Service Department, Standard Brands, Inc. New England's nature trails provide a change from the canyons of Manhattan where Mr. Nordsiek works and lives.

Security. — Shortly after the July issue of The Review published his "Promise of Technology," LUIS DE FLOREZ '11, breaks into print; this time with an examination of the training of tomorrow's engineers. His article (page 91) bears the authoritative stamp of much experience. The author is president of the de Florez Engineering Company, Inc., and vice-president of Doubleday and Company, Inc. He was director of the Special Devices Division of the Bureau of Aeronautics in 1943–1945, deputy chief of Naval Research in 1945, the same year in which he was made rear admiral. In 1944 Admiral de Florez was the recipient of the Robert J. Collier Trophy for achievement in aviation.

Sedgwick. — The impressions which a great M.I.T. teacher left on one of his students is recorded (page 94) by JAMES A. TOBEY, '15, whose long and useful career in public health makes him especially qualified to evaluate the professional work of biologist William T. Sedgwick who developed and expanded the Course in Biology at the Institute. From M.I.T. Dr. Tobey received the S.B. and Dr.P.H. degrees in 1916 and 1927, respectively, and, in addition, received LL.B. and M.S. degrees in 1922 and 1923, respectively, from Washington Law School and the American University. Dr. Tobey has served numerous private and governmental agencies on public health matters, has been associate editor of the *American Journal of Public Health*, and a frequent writer on topics of public health. Among his writings are several books, including *Public Health Law* and many magazine articles. It is a pleasure to welcome Dr. Tobey once more to the columns of The Review as a contributor of long standing.

Structure. — Inveterate photographer and extensive traveler, C. E. PATCH, '02, brings to The Review (page 83) the text, engineering drawings, and photographs of the Stillwater covered bridge between Old Town and Orono, Maine. Since no plans or specifications of the bridge could be found, the drawings and dimensions were reconstructed from the present structure. Mr. Patch is treasurer and industrial engineer for the Morton C. Tuttle Company of Boston.

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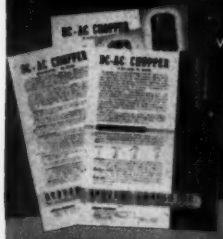

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Catapulting Capers

FROM ASA L. CARTER:

"Only once in the history of technology has a flywheel served for power storage in the same sense in which an electric battery is used for power storage." (Technology Review, page 16, Volume 53, November, 1950). I think this error should be corrected. See the articles about the "Electropult," in the following publications: *Aviation*, page 62, Volume 45, October, 1946; *The Engineer*, page 379, Volume 182, October 25, 1946; *Popular Science Monthly*, page 81, Volume 149, November, 1946.
Pittsburgh 28, Pa.

[*The article "Flywheel Engines" was included in the Trend of Affairs section of The Review and concerned the use of a flywheel as motive power for a gyrobus. The articles to which Mr. Carter refers describe an electric catapult system for launching large aircraft. Essentially, the assisted take-off system comprises an unusual form of induction motor with the rotor laid out as a flat track 1,382 feet long; the stator in the form of a small shuttle car which runs linearly along it to accelerate the aircraft during take-off. In this system, a 1,100 horsepower aircraft engine drives a D.C. generator coupled to a D.C. motor which in turn drives an A.C. generator and a 24-ton flywheel. A period of about eight minutes is required to accelerate the flywheel to its full speed of 1,300 revolutions per minute just before launching. When an airplane is launched, the energy stored in the flywheel is used to drive the A.C. generator to supply electrical power during four to five seconds for which the accelerating power is required.*

Comments, such as the above from Mr. Carter, are always a welcome indication that The Review is carefully and critically read, and we are happy to be reminded of the highly interesting development of the electropult. Evidently there were applications, other than the Howell torpedo, in which "a flywheel served for power storage in the same sense in which an electric battery is used for power storage," even though the delivery of such power did not extend for more than a small fraction of a minute.—Ed.]

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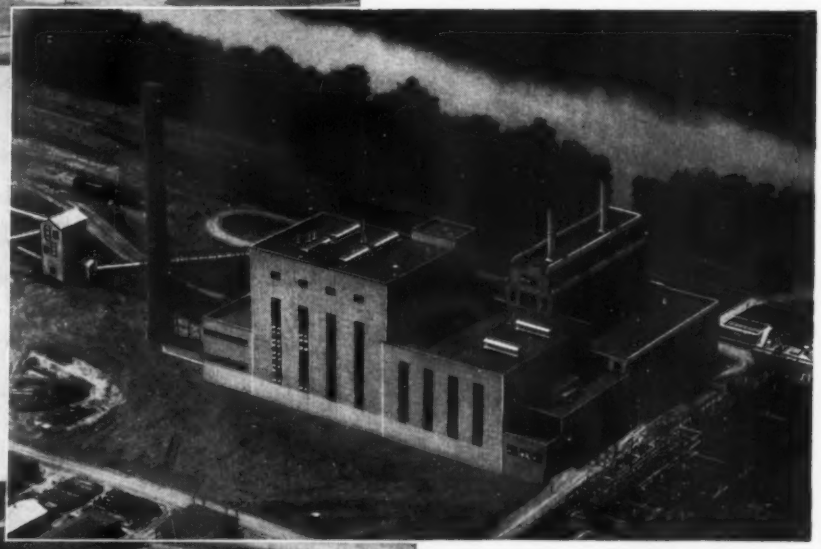

1. *Chesterfield Power Station, first with an installed rated capacity of 50,000 kw, has been extended with an additional installed rated capacity of 60,000 kw.*
2. *Recently completed Bremo Power Station extension, 60,000 kw rated capacity.*
3. *Possum Point Power Station where an extension of 60,000 kw rated capacity is under construction.*

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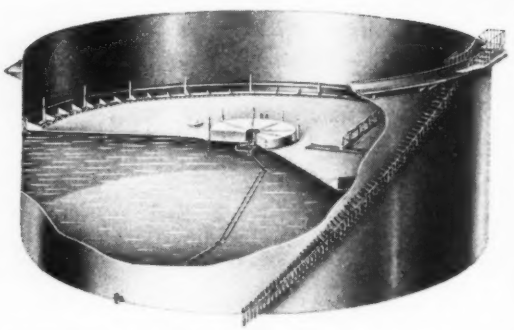
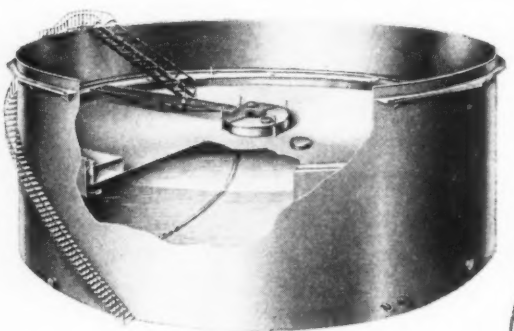


PAN-TYPE Center-Weighted Floating Roof . . . for southern climates where rain is the only weather problem.



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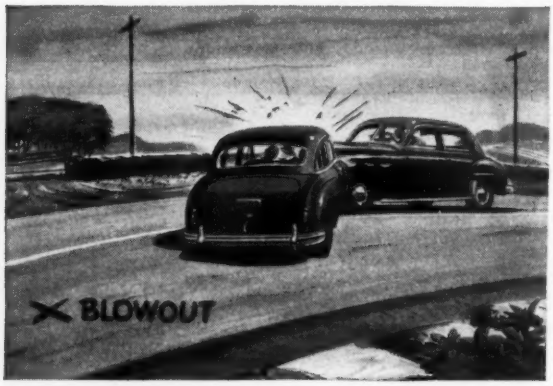
MY BUSINESS KEEPS ME IN THE CITY. I CAN'T AFFORD TO BE DELAYED BY FLATS. THAT'S WHY I PUT IN GOODYEAR PUNCTURE SEAL TUBES!



IF YOU DRIVE MOSTLY ON HIGHWAYS at usual highway speeds, don't risk a *blowout* — the explosive loss of air that can mean sudden loss of control and tragedy for you and your family. You need Goodyear's LifeGuard Safety Tubes—the remarkable tubes that make a blowout *harmless!*

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How LifeGuard Safety Tubes can save your life!

1. LifeGuards have *two* air chambers. In case of blowout, only outer chamber gives way.

2. Reserve air in cord fabric inner chamber supports car long enough for a safe, smooth stop.

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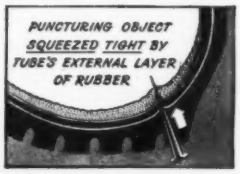
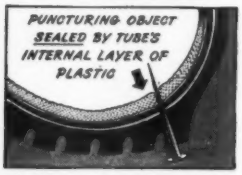


1. Tube is *compressed.* When pierced, it grips firmly, instantly. Prevents escape of air.



2. Gummy plastic closes in around object. When object is removed, plastic seals hole.

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THE TECHNOLOGY REVIEW

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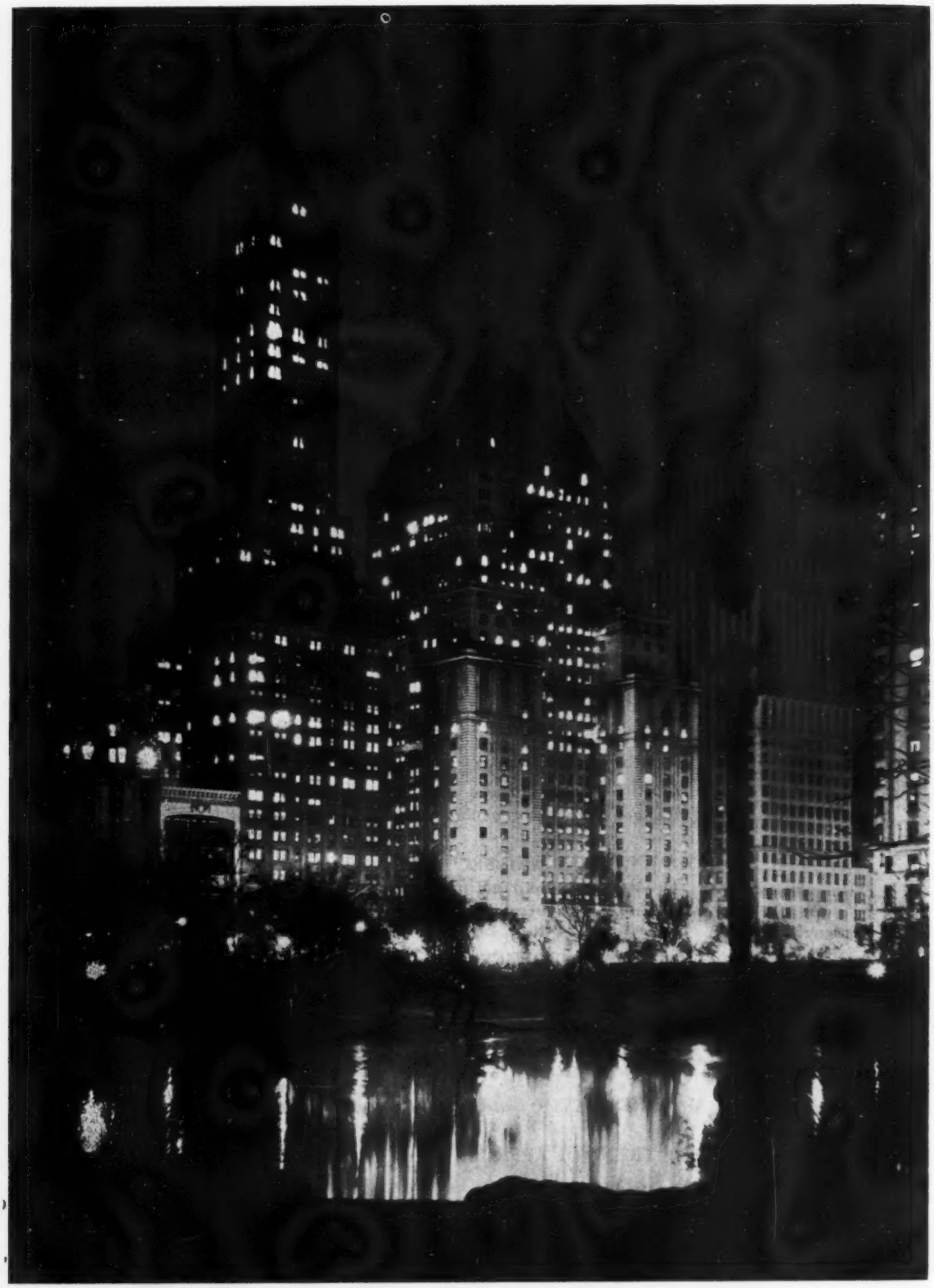


Edward B. Noel from Black Star

"The night has a thousand eyes . . ."

—Francis William Bourdillon

THE
TECHNOLOGY REVIEW

Vol. 53, No. 2 December, 1950

The Trend of Affairs

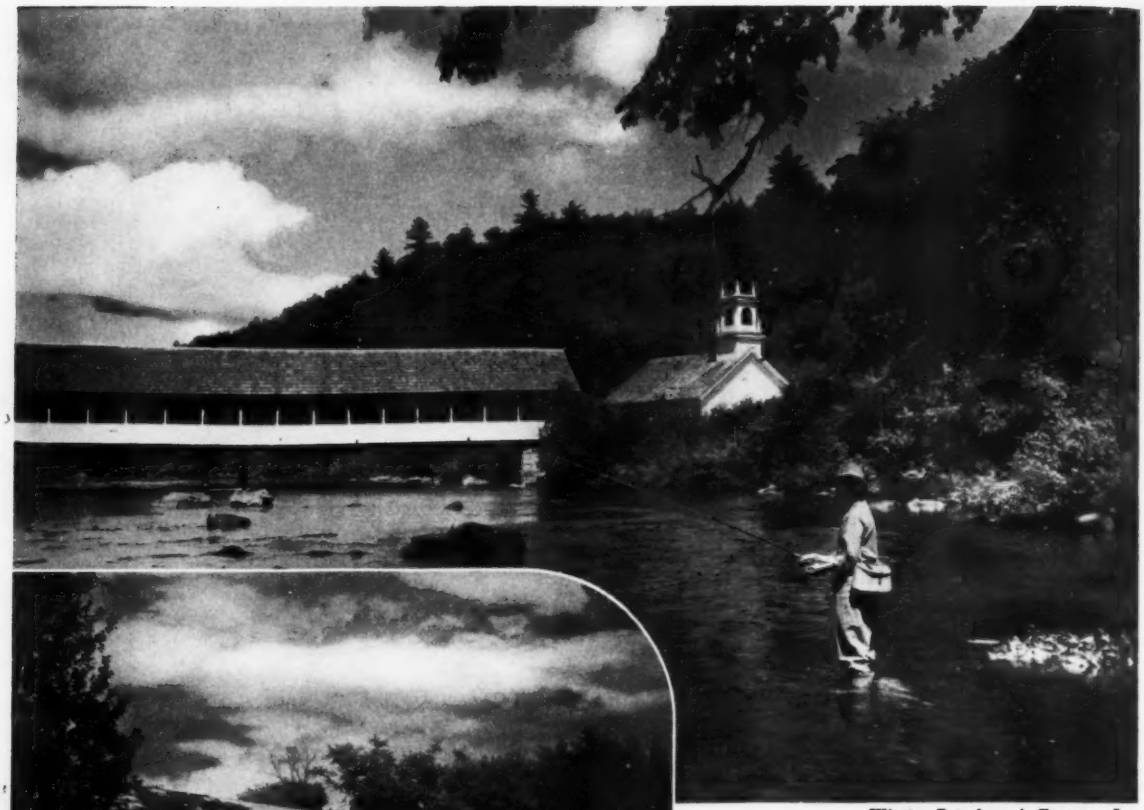
Salts of the Earth

REPLETE with paradox is the relationship of the effect of earth minerals on human health. A classic example in this category is the occurrence of simple goiter and cretinism in certain inland regions, attributed to a deficiency of iodine caused by low levels of this element in the local soil, vegetation, and water. Drinking water is one normal source of beneficial iodine, and therefore it is theoretically possible to rectify a lack of this element by adding it to water supplies. In practice, however, the most expedient means of supplying iodine is the use of iodized salt for seasoning food.

Fluorine, another halogen element closely related to iodine, may have either baleful or beneficial effects when consumed in drinking water, depending upon the concentration present. An excessive amount of fluorine in water drunk during the early years of life, when the teeth are being formed, causes an unsightly irregularity in the outer tooth layer known as "mottled enamel." As systematic investigation of mottled enamel was undertaken, the paradoxical discovery was made that fluorine ingested in lower concentrations apparently has a beneficial effect upon the teeth, by increasing their resistance to decay. This observation is now being checked through long-term studies in communities where fluorides are added in controlled amounts to the public water supply. Meantime, it has been learned that fluorides also appear to inhibit dental decay when applied directly to the teeth.

A recent advance in knowledge of the effect of earth minerals upon human beings was discovery of the cause of a previously baffling disorder in infants that labors under the sesquipedalian designation "methemoglobinemia." This serious, sometimes fatal, condition occurs only in very early infancy, and has been observed on this continent mainly in the north central United States and the central provinces of Canada. It is manifested as failure of the blood stream to convey oxygen to the body tissues, resulting in asphyxiation. The cause of methemoglobinemia is now known to be high concentrations of nitrates in well waters in the affected localities. Methemoglobinemia is limited to young infants for a most curious reason. Nitrates as such are innocuous, but these salts are reduced to nitrites by a type of intestinal bacteria that normally occurs only in infants during the first few weeks of life. The nitrites thus formed are the direct cause of the trouble. Adults may drink nitrate-laden water with impunity because their intestinal bacterial flora do not reduce the nitrates. So far, no public water supplies have been implicated as a cause of methemoglobinemia; all of the known cases have been traced to shallow wells, frequently of improper construction and location.

Thus man holds within his grasp the means for controlling the effects of iodides, fluorides, or nitrates occurring in the earth, as these minerals enter the human body in solution in water supplies. Iodized salt is the key to prevention of goiter and cretinism. Universal use of iodized salt is in fact advocated, as a moderate surplus of iodine does no harm. Legislation to require iodizing of all salt for human consumption in the United States is under consideration, but is not being pushed at present in the hope that educational activities will accomplish voluntary universal use of iodized salt. Water supplies containing excessive levels of fluorides or of nitrates are preferably condemned and replaced with other sources, or at least are kept from the age groups to which they do their respective types of harm. If the long-term studies bear out earlier findings, a sufficiency of fluorides to promote dental health may be assured either through controlled addition of this element to public water supplies, or by direct periodic application to the teeth.



Winston Pote from A. Devaney, Inc.

(Above): *Covered bridge over the Ammonoosuc River at Stark, N.H.* (Left): *Old covered bridge across the Swift River on Route 302 near Conway, N.H.* (Below): *Near Jackson, N.H., where Ellis River joins Wildcat Brook, one may find this fine example of the covered bridge.*

David W. Corson from A. Devaney, Inc.

As these photographs indicate the picturesque covered wooden bridge has not yet entirely passed into oblivion.

The reasons for covering a bridge are not always readily apparent to today's traveler through the rural sections where such structures may occasionally be found. Yet the roof structure, which was comparatively light and easy to repair, must have been effective in reducing the deterioration of the heavier structural members, and afforded at least some relief in keeping roads open during the seasons of heavy snow.

The Passing of the Covered Bridge

By C. E. Patch

To silhouette the unhurried, serene, unrepining past against today's raucous bustle, few man-made structures serve as well as do the covered bridges spanning the streams and rivers in certain rural sections of the United States. Perhaps most numerous in New England, where they were originally built without benefit of any but the most simple rule-of-thumb engineering principles, these wooden tunnels "leading from light to light through a brief darkness" may yet be found occasionally in the middle western and central states in regions not yet wholly converted to the rising tide of stainless steel and plywood as building materials. Nevertheless, these protected crossings have undoubtedly seen their zenith and (like the cigar-store Indian, the one-horse chaise, or the practice of making purchases for cash in a state of dignified solvency) are rapidly becoming relics with which only the old fogies may have had contact.

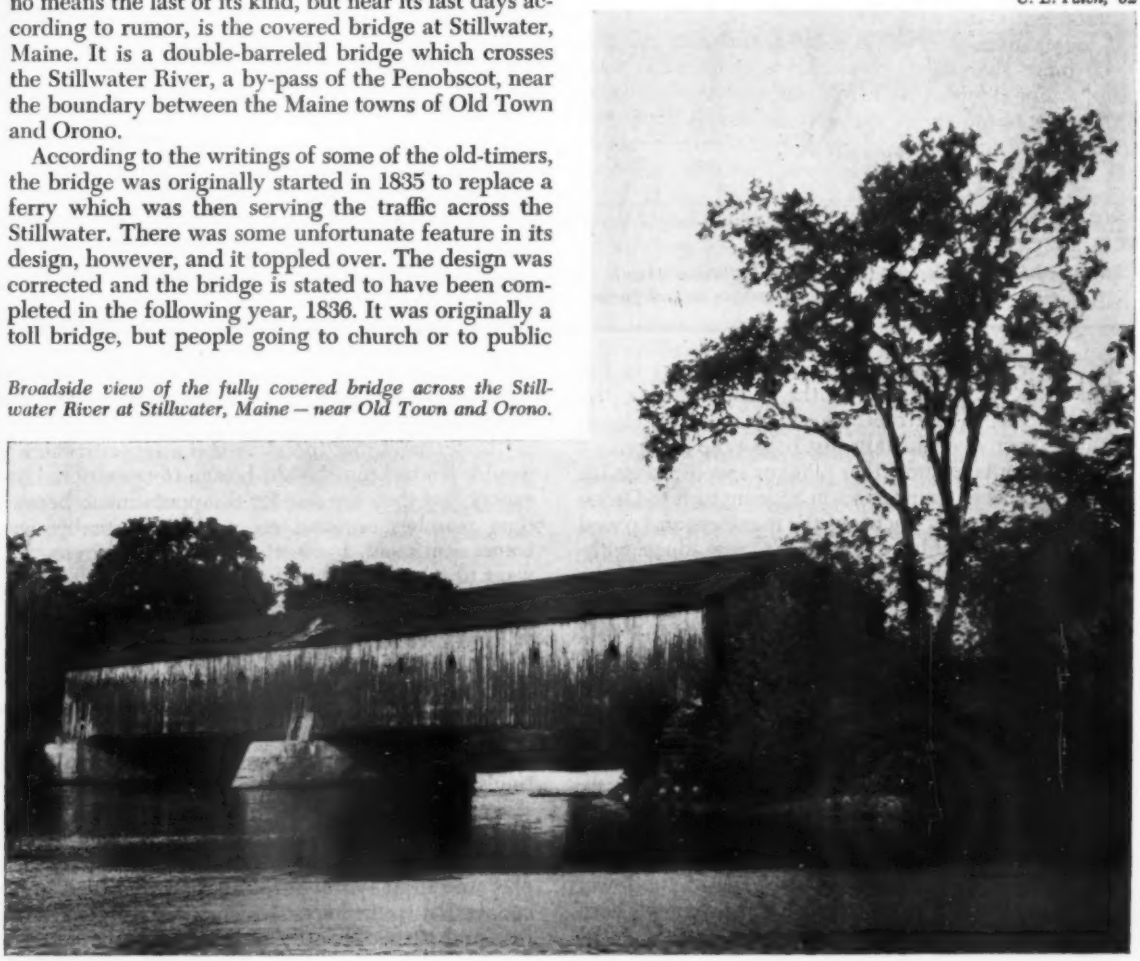
Possibly Vermont and New Hampshire lead in the number of covered bridges still fit for use. But Maine, too, can afford interesting examples of ducts which, if they no longer resound to the jog trot of Old Dobbin's ironshod hoofs, still rumble at the passage of today's cushioned four-wheel vehicles. One such bridge, by no means the last of its kind, but near its last days according to rumor, is the covered bridge at Stillwater, Maine. It is a double-barreled bridge which crosses the Stillwater River, a by-pass of the Penobscot, near the boundary between the Maine towns of Old Town and Orono.

According to the writings of some of the old-timers, the bridge was originally started in 1835 to replace a ferry which was then serving the traffic across the Stillwater. There was some unfortunate feature in its design, however, and it toppled over. The design was corrected and the bridge is stated to have been completed in the following year, 1836. It was originally a toll bridge, but people going to church or to public gatherings were exempt from payment. It was purchased by the town and made a free bridge about 1870.

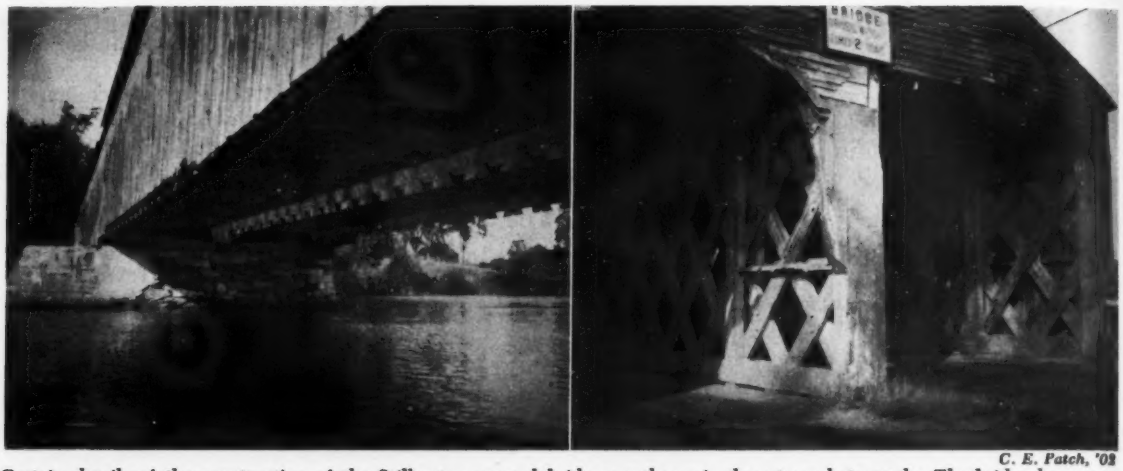
The historians tell that not long after its completion, the bridge served as the assembly place for an important meeting of the citizens of Stillwater Village. It seems that the village was to decide whether it would become a part of Old Town or of Orono. The bridge furnished not only an assembly place for the meeting but a convenient polling mechanism as well. All those citizens in favor of uniting with Old Town were told to assemble at one side of the bridge, and those in favor of Orono to gather on the other side. The official tellers then made the count and declared in favor of Old Town by a majority of 25 or so votes. One man on the Orono side who saw how the vote was going, and just didn't want to be among the losers, is claimed to have crawled through the center truss to the Old Town side in time to be counted with the winners.

The bridge is a monument to the Yankee mechanics of the early part of the Nineteenth Century and has withstood the elements well for more than a century. I quote from a letter from the bridge engineer of the State Highway Commission of Maine: "In 1936 there was only very slight damage to the superstructure, and I am very sure that in making repairs at that time

C. E. Patch, '02

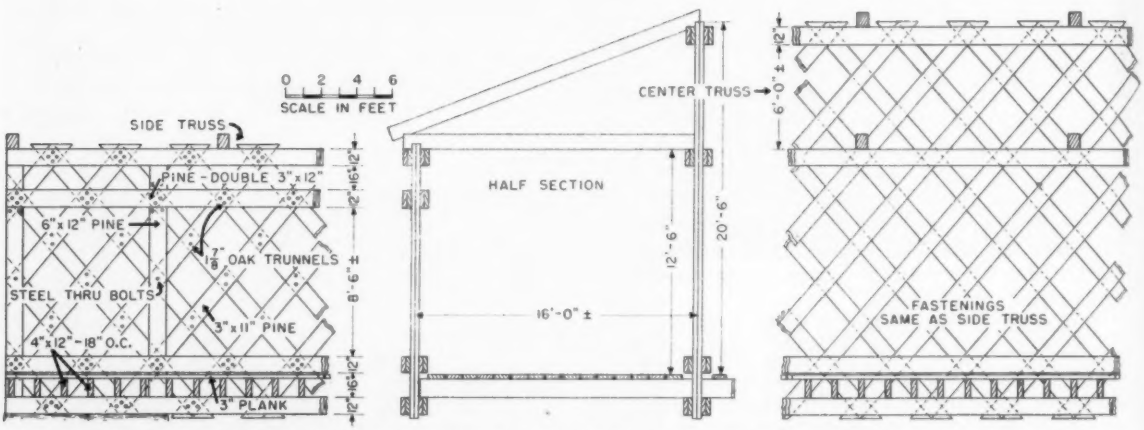


Broadside view of the fully covered bridge across the Stillwater River at Stillwater, Maine — near Old Town and Orono.



C. E. Patch, '02

Certain details of the construction of the Stillwater covered bridge are shown in these two photographs. The bridge has a span of 210 feet, with a center and end supports of stone as shown at the left. Entrance detail is shown at the right.



Structural details of the wooden bridge at Stillwater, Maine. The details are reconstructed from the bridge as now standing, since attempts to find plans or specifications were fruitless.

the Town did not make any material change in the construction." According to the Bangor *News*, the damage was to the roof, of which a part, at least, floated down over the falls just below the bridge.

All attempts to find either plans or specifications for the bridge were fruitless, so on a recent visit to Orono I took some measurements of the members and paced the spans, so that I have been able to reproduce, without too much error I hope, the structural design of the bridge. The main members seem to be of pine, and probably when the bridge was built there were plenty of big saw timbers of this species of tree growing within logging distance of the site, and plenty of mills in the neighborhood to saw the logs.

While there are a few metal fastenings near the ends of the bridge, the bulk of the connections are made with oak trunnels 1⅞ inches to 2 inches in diameter. Doubtless it was the custom to drive these trunnels in as nearly a completely dry state as possible so that they would always be tight under conditions of normal humidity. At the level of the lower members of the roof trusses there are some 19 horizontal sway-bracing X panels in the length of the bridge on each side. The diagonals appear to be about 4 inches by 6 inches and are notched into the roof members.

I understand that there are still a few citizens who would like to keep the old bridge in operation, but I expect that they are due for disappointment, because time marches on, and economics eventually overcomes sentiment. I sometimes wonder if anyone will want to inherit my broad razors.

Weep No More

THE humble onion and the robust garlic have been the butt of many jokes. Nevertheless, even those persons who ostensibly scorn these plebeian vegetables in reality, often relish their flavor when unwittingly consumed in low concentrations in soups, sauces, dressings, and similar prepared foods.

In order to avoid tedious preparation and also for facility in storage, both onions and garlic have been prepared in dehydrated form. The experience in this connection is of interest because the behavior of onions and garlic when dried has been found to differ

sharply from that of other vegetables, as well as from that of spices. For example, if onions or garlic are either blanched or sulfited, a flavorless dried product results. Ordinarily, either blanching (application of heat) or sulfiting (exposure to sulfur dioxide) is an indispensable preliminary step in the dehydration of vegetables – employed for the purpose of destroying or inhibiting enzymes naturally present in all plant tissues; otherwise, such enzymes usually cause deterioration of the dried product.

Another puzzling discovery was that spray-drying of either onions or garlic also resulted in a flavorless product. Spray-drying involves reduction of the material to be dried into finely divided form, and the forcing of this magma through a minute orifice into a drying chamber.

An explanation of both aspects of the anomalous behavior of onions and garlic in dehydration may be anticipated from the observation that intact onions or garlic are relatively odorless. This has been explained on the theory that the aroma and flavor principles (and incidentally also the lachrymal factor that causes weeping while onions are being prepared) reside in precursors that require activation by enzymes. Both precursor and enzyme occur within the vegetables, but are kept apart by cellular tissues. Therefore, when onions or garlic are cut, chewed, or otherwise broken up, precursor and enzyme come in contact and the aroma and flavor are released. Either blanching or sulfiting destroys the flavor potentialities of onions and garlic by destroying the activating enzyme.

Spray-drying is unsatisfactory because the necessary preliminary maceration liberates the flavor, which because of its labile nature is then destroyed during the drying operation. Dehydrated onions or garlic may nevertheless be ground into fine powder once they have been dried in the form of slices or chips. This is possible because the flavor precursor and the liberating enzyme do not interact in the absence of moisture, even though in contact. When such powders are moistened during food preparation, the flavor is released.

The flavor mechanism of onions and garlic just described also departs radically from that of spices. Spice flavors reside mainly in essential oils that retain their seasoning value when separated from the spice plant, and therefore may be isolated in potent, stable form by solvent extraction or by distillation. As a result, spice oils and other spice concentrates are widely used in the food industries in place of whole spices. The knowledge of the flavor mechanisms of onions and garlic summarized above has made possible the successful dehydration of these widely used condiments, thus providing them in similarly concentrated and convenient form.

Outguessing Mars

In time of peace, the largest customer of American industry is the Department of Defense. In time of war, the demands of our armed forces have been so immense and varied that they have strained and shaped the entire economy. To our great misfortune, the possibility continues to exist that such demands may have to be made again, and on a scale even exceeding that of World War II.

The ability of American industry to produce whatever engines of war may be required in the future is naturally under constant investigation by the military services; for example, one specific agency is the Industrial College of the Armed Forces. It is hardly to be expected that the problems and decisions of such bodies will be publicly discussed, but certain trends which this economy may be called on to meet with its machine tools, assembly lines, and above all, its trained man power are apparent merely from a reading of history. The following comments, though they merely graze a massive and refractory problem, may serve a useful purpose if they call attention to one of the most important aspects of this country's defense.

In World War I, when London was bombed by Zeppelins, the physical damage was scarcely noticeable. In the total panorama of the conflict, the raids struck a bizarre rather than an ominous note. The characteristic weapon of World War II, on the other hand, was the heavy bomber. Air bombing inflicted massive damage on every major city in Europe except Paris and Rome, and was even more devastating in Japan. It will take generations to heal the wounds, visible and invisible, that air power has inflicted on Western civilization.

Does this imply that, in a future conflict, industry will be called on to build even more and bigger bombers, not to mention other types of aircraft? Here at least is an obvious answer to an obvious trend. Yet there are doubters, the age of air power is still on the rise. Such skepticism does not arise entirely from the improvements that have occurred in antiaircraft measures, although some of these are of large proportions. It has been stated, for example, that, early in World War II it took about 1,000 shells to bring down an airplane (nearly a tenfold improvement over the ratio at the beginning of World War I). Toward the end of the war, however, it was taking about 500 shells with mechanical fuses; with proximity fuses, less than 100 shells were required. That one invention had caused a fivefold improvement. Whether the latest improvements in radar, fire-control instruments, and proximity-fused shells are sufficient to nullify the improvements that have occurred in airplanes is probably a matter for speculation, even to the informed military. The layman must drop the subject in favor of a still more speculative one – the possibilities of guided missiles as antiaircraft devices, as short-range bombers, and, in the dim future, as the primary carriers of long-range fire power. It would be a major irony of military history if, just as the piloted airplane had won virtually unqualified recognition as the offensive arm par excellence, it were replaced by an automatic dingus in some of its characteristic functions.

The shortcomings of present guided missiles are many and stubborn. Among other failings they lack range and precision. Compared, however, to the airplane at a similar stage of development, they are veritable models of perfection, and particularly if a new conflict is sufficiently far in the future so that various fundamental research programs can be completed, the likelihood that they will be a major arm is strong. During World War II the Germans built about 20,000

flying buzz bombs, or *V-1's*, and about 3,000 of the *V-2's*. There is little comfort in the fact that against London, and particularly during the later attacks against Antwerp, the relatively low-speed *V-1's* were singularly ineffective. Against the supersonic *V-2's*, the only defense conceived during the war was to bomb their launching platforms and supply points. In the words of Albert Speer, one of the top German air leaders, the flying bomb has had its day, but the rocket must be considered the future long-range weapon.

Whether they are small or large, long-range or short-range, rocket or jet-engine powered, missiles may be required in tremendous numbers. Perhaps the air frames, fuels, and propulsion systems of these missiles will present no unusual problems, and will be regarded by industry as merely another product to be produced at so many pounds to the man-hour. But each missile, whether used to replace an antiaircraft shell or to carry an atomic war head, must contain a complete control and guidance system – a mass of radars, amplifiers, fuses, servomechanisms, and gyroscopes – and all of these will be difficult to produce, difficult to assemble, difficult to calibrate.

Nor does it follow that American industry will be allowed to carry out these delicate tasks in quiet, clean factories each of optimum size, and located so as best to tap available supplies of labor and materials. Every nation with the necessary industrial potential is now straining to produce atomic weapons. It does not necessarily follow, however, that such weapons will be used in any new war. The major belligerents all built up ample stocks of poison gases during the last conflict but such manufacture and stock-piling did not lead to the use of gas. Nevertheless, the threat of these atomic bombs and gases, not to mention other new weapons, will increase the pressure to disperse key plants, to put them underground, to move them into empty areas of the country where there is less danger of being bombed out. With such dispersal will come greater difficulty in getting ample supplies of skilled labor and of producing intricate subassemblies.

A further complication of industry's problems is the unfortunate fact that probably never again will the United States enter a war as rich in natural resources as she was in 1940. For more urgent reasons than have ever before existed, the United States will have to control the seas. To operate at full war potential a decade or so in the future, this economy may well have to make bulk imports of oil, iron ore, bauxite, manganese, chromite, and dozens of other materials. To keep the war from our shores, this country will have to send abroad convoys of soldiers and supplies. A great shipbuilding effort will again be necessary, although very probably the stress will be placed on producing different types of ships than were needed in the last war. It is not sufficient that we be able to draw on a great moth-ball fleet. If, for example, naval warfare becomes primarily a battle between submersibles, as well it might, the United States may be forced to exceed Germany's remarkable effort of building, on the average, one submarine for every two days of the war. Without counting midget types, or boats not carried to completion, the Germans built 1,155 submarines during World War II.

In one vital resource, however, this country is gaining rapidly. The number of engineers in this country – which was about 27,000 in 1890, and 260,000 in 1940, and is believed to be somewhat in excess of 350,000 today – is expected to climb to about 460,000 by 1960. Engineering schools are currently turning out about 30,000 graduates per year, compared to an average of about 10,000 per year before the war; in some estimates this figure is increased by as much as 50 per cent. The present rate is expected to decline, possibly reaching a low point of between 10,000 and 15,000 about 1954. It appears likely that perhaps 20,000 new engineers will be added to our economy yearly during the next decade and a half.

It is regrettable that man's present state of political and ethical development has not reached such a point of advancement as would definitely preclude the possibility of armed conflict or other uses of force to achieve a goal. The machinery for averting such a catastrophe has been established, however, and so long as it operates, however imperfectly, there is hope that the voice of Mars may be limited in its extent. But if we take a realistic point of view, and no other is possible for survival under present conditions, the next best solution is to bend every effort toward outguessing Mars.

Man as a Meter

As we bring to a close in this issue the two-part article by Frederic W. Nordsiek, '31, on the human senses, word comes from London of a Conference on Subjective Judgments in which the main topic of discussion was the use of man as a meter to measure his surroundings.

Nearly 200 physicists, engineers, and psychologists convened at University College, and discussed experimental techniques using the taste, touch, sight, smell, and hearing of human subjects. The conference divided itself into two opposing groups: those who maintained that measurement of sensations was not possible and who pointed out the fallacies of experimental methods; and those who insisted that however philosophically unsound their techniques might be considered in the light of existing knowledge, they served their purpose if they gave data of precise operational value.

A topic which raised much discussion was the use of trained observers, defined as intelligent people capable of understanding the nature of the observations required of them.

The conference raised much greater interest than had been anticipated and it appears that the time is ripe for the techniques of subjective studies to be codified. It is interesting to observe that, in large measure, the success of the London conference was dependent upon the interchange of ideas of authorities from widely different fields, in order to help in bringing about the necessary measuring instruments which should, in due course, lead to increasing speed and efficiency in the practice of subjective assessment. The same policy has been followed in the United States and is actively pursued in the Institute's research activities.

All Experience Is of Changes — II

Although Better Basic Understanding of Sensory Mechanisms Is Sorely Needed, Great Improvement in Sensory Utility Can Be Achieved by Intensive Training of Perception

By FREDERIC W. NORDSIEK

THE first section of this article, which appeared in the November issue of The Review, showed that there are some dozen more or less defined human senses. An examination of sight and hearing indicated that these senses are cardinal to man's intellectual activities. Attention was also given to the devices which man has enlisted to aid his vision and hearing. Let us now turn to those human senses that have lower intellectual status, and for which man has had little success in developing aids.

The Finical Chemical Senses

Olfaction and gustation are usually classed together as chemical senses, although some of the dozens of theories that have been propounded[10] to explain the mechanisms of odor postulate that this sense results from a physical, rather than a chemical, stimulus.[11]

In technical importance, the chemical senses lie median between vision and hearing on the upper level, and the cutaneous senses on the lower. Similarly, human acuity in the chemical senses is determined less often than acuity in sight or hearing, but more frequently than acuity in the cutaneous senses. Thus, few persons pass through life nowadays without having their vision tested, even if only by a school nurse or motor vehicle inspector using the familiar Snellen visual acuity chart with its letters of varying sizes. Some people experience crude hearing tests, such as determination of the distance at which the ticking of a watch is heard, applied by a physician to test hearing after the healing of an ear infection. A few persons undergo accurate hearing tests by means of an audiometer during an examination by an otolaryngologist, or as part of hearing conservation programs carried out by public health agencies. In general, the only individuals who experience any test of their acuity in the chemical senses are certain employees of food, beverage, or perfume concerns.[12] These are the persons who participate in the product development and quality control programs of such companies, either as experts or as members of flavor or odor judgment juries. Finally, acuity in the cutaneous senses is never tested, except insofar as such faculties contribute to manual dexterity, measured by tests given for vocational guidance or personnel hiring purposes.

Such studies as have been made of acuity in the chemical senses have led to certain broad conclusions. Thus, women have been deemed to have more sensitive taste (not flavor) perception than men.[13] Teen-age boys and girls have been found to be more discerning than adults in the judging of oranges.[14] This latter conclusion is reinforced by the histological observation that taste receptors are more numerous in the oral cavities of children than of adults.

Anosmia has been studied. This deficiency of the smell sense may be inherited or acquired, and may be structural or functional. Total human anosmia is unknown, but partial anosmia is common. The study of partial anosmics holds much promise for elucidating the basic mechanisms of odor, just as research with partially color-blind persons contributed to knowledge of vision.[15]

A member of the chemical sense group is the so-called common chemical sense, the receptors of which are undifferentiated nerve endings in the mucous membrane lining of the nasal and oral cavities. The sensation of the common chemical sense is nonspecific, that is to say, the same regardless of the stimulating substance. The common chemical sense is much less subject to adaptation or fatigue than are the other chemical senses; thus olfactory sensitivity quickly diminishes to a strong and continuing odor, whereas the common chemical sense sensation produced, for example, by ammonia or chlorine fumes does not dwindle, no matter how long the stimulus is continued. Heavy stimulation of the common chemical sense, as in the examples just cited, is unpleasant or even painful. Nevertheless, common chemical sense sensations from lighter stimulation have hedonic value, as part of the flavor of pepper, strong alcoholic beverages, and many other items of food and drink.

Although a single substance may be capable of stimulating all of the chemical senses, the threshold concentration necessary to produce a perceptible sensation may be widely different for each of the senses.[16] Thus ethyl alcohol can be smelled in the air in a concentration of 0.44 per cent. But dissolved in water, ethyl alcohol must reach a level of at least 14 per cent in order to be tasted. Finally, an aqueous solution of ethyl alcohol of 25 per cent or higher concentration stimulates the common chemical sense receptors. Viewed in this wise, the sense of smell is 30 times more acute than the sense of taste. This ratio is greatly increased, however, by making the comparison with different stimuli for each sense (although purists may challenge the legitimacy of such comparisons). Thus strychnine hydrochloride, one of the most highly sapid substances, is detectable in water in a concentration of 4×10^{-8} per cent. A highly odorous substance, ethyl mercaptan, is noticeable in the air in a concentration of 3×10^{-9} per cent. On this basis, the sense of smell is 10,000 times more acute than the sense of taste.

The Evocative Sense

No other human sense has as great nostalgic power as the sense of smell.[17, 18] The faintest whiff of a perfume characteristically affected by an absent loved one will do more to evoke an image of that person than any other memento. When the author attended M.I.T. and also lived in the Institute dormitories, the Institute grounds were frequently invaded by fumes of nitrobenzene from the nearby shoe polish factory. As a result, nothing "takes me back to Tech" more powerfully than the odor of nitrobenzene. Whenever a flavor appears to have evocative power, as when the chewing of a mint leaf conjures up the image of an open sunny meadow to one who as a child hunted wild mint on the countryside, such a flavor may usually be demonstrated to be essentially an odor, if the sensation disappears when the nose is held shut.

As the human head evolved to its present shape and thereby lost the prognathous conformation of the skull of apes, the area of the epithelium that is sensitive to odor was thereby reduced to a mere five square centimeters in each nasal cavity. For this reason alone, it is not surprising that man has a less acute sense of smell than the lower mammals. Nevertheless, as already cited, ethyl mercaptan is apparent to the human nose in a concentration of but one part in 30 billion, and numerous other substances can be smelled by man in similar dilution. Such concentrations are considerably smaller than may be detected by most of the available chemical or physical analytical methods. From these facts it becomes easy to infer what an exceedingly sensitive faculty the lower mammals must possess in their sense of smell.

An index of man's limited reliance upon the odor sense is the absence of human smell reflexes. Thus the hand is spontaneously withdrawn when a hot surface is unexpectedly touched, and this reflex action is so quick that it is accomplished before there is consciousness of a sensation of heat or pain. But any chain of activity that is impelled by an odor sensation must originate consciously in the brain. Similarly, man has a poor, or at least an undeveloped, odor memory. Try to recall your previous meal. The appearance of the foods comes readily to mind, whereas any independent recollection of the odors of the foods is difficult to accomplish. Lower mammals apparently have a better odor memory, as illustrated by the ability of a dog to follow a man's trail after the dog has been acquainted with the scent of his quarry.

Paul Faris from Black Star

Relationships between chemical constitution of substances and the odor sensations they produce are not well understood. In general, however, the odor of a compound depends more upon molecular structure than upon the elements present in the molecule. But an exception to this broad rule lies in the fact that many sulfur compounds have offensive odors. In a homologous series of odorous substances, odor strength usually rises with increasing molecular weight to a certain point; above this molecular weight, odor strength progressively decreases because of decreasing volatility. But beyond a few such known relationships, all is chaos. On one hand stereoisomers, compounds that differ only in extremely subtle spatial relations within the molecule, sometimes have totally different odors.[19] On the other hand, substances that differ totally in chemical constitution may have similar odors. Odor sometimes depends as much upon concentration of the stimulus as upon its nature; thus indole and ambergris have pleasant odors when dilute but are very revolting in heavy concentration.

Thousands of odors that can be clearly differentiated by the human being are known. In general, nevertheless, absolute terms for designating odors are lacking. Thus, although a taste may be described as sweet, rather than stating that it is like sugar, odors can be described only as floral, meaning like flowers, fishy, meaning like fish, and so on. Several nomenclatures for odors, and systems of odor classification, have been proposed. All of these are arbitrary, complex, and occasionally the subject of torrid controversy. Nevertheless, like any classification system, arbitrary or rational, odor nomenclatures serve a useful purpose as guideposts to those conducting a systematic study of odor phenomena.

The sense of smell has marked adaptation, or decrease in sensitivity resulting from continued exposure to a strong stimulus. Such adaptation is fortunate, as it provides the only available protection against obnoxious odors, other than the strictly limited defense of holding the nose and breathing through the mouth. Odor adaptation has, in addition, found practical application in the qualitative resolution of mixtures of odorous compounds. To accomplish such identification, the predominant component of the mixture is first recognized by odor. Then a portion of this known substance in pure form is sniffed vigorously, thus adapting the olfactory receptors until they are no longer sensitive to the odor of this particular substance. Then when the mixture is again smelled, the second most predominant component becomes apparent. Now the nose is adapted to a mixture of the two substances so far identified, and so on until the entire mixture has been explored.

Good Taste

There are four tastes, thousands of odors.[20, 21] Since flavor is a combination of taste and odor, plus cutaneous sensations and sometimes also the common chemical sense sensation, the great complexity of flavor is apparent. Nevertheless, flavor is a fundamental practical concern of the food industry because this characteristic is the principal, and sometimes the only, criterion of acceptability of foods to the consumer. Beverage manufacturers are equally concerned with flavor. Although the act of swallowing a fluid closes off the nasal passages and thereby blocks the odor component of flavor, flavor sensations in all their ramifications are produced by the residues of a beverage that linger in the mouth after the actual act of swallowing is terminated. The major hopes for exploring flavor phenomena at present lie in separate studies of each of the several sensations that add up to make flavor. Thus, research is devoted to the odors of foods as such[22] and in addition the true tastes are studied intensively.[23]

As a result of the complexity of flavor and the lack of knowledge of its primary mechanisms, flavor acuity of an individual and flavor value of a food can both be determined only empirically. Therefore, such studies demand statistical interpretation.[24] In the food and beverage industries, the usual practice is to establish flavor standards for a product by means of broad consumer tests. The participants in such tests are required to mirror the spontaneous or untutored point of view of the average consumer. They may be drawn from nontechnical employee bodies, or may be members of the general public reached by a Gallup-poll type of procedure. Once the flavor standard for a product has thus been established, adherence to this standard is routinely checked by experts. Such experts may be individuals, like the professional tea and coffee tasters, or may be a committee or panel chosen for initial flavor acuity and then trained to make particularly fine discriminations in the product under consideration.[25] In general, however, training is recognized to be vastly more important than original acuity; and persons with only fair initial flavor acuity are considered to be satisfactory candidates for flavor panels. Both inherent acuity, and the ability to make flavor discriminations acquired through training, may be highly specific. For example, a skilled tea taster may be no more discriminating than an untutored layman in the flavor-testing of dairy products.

Some human beings suffer from a hereditary defect of the taste sense roughly analogous to hereditary color blindness.[26] To approximately 40 per cent of the Caucasian population (but 6 per cent of American Indians) the compound phenyl-thio-carbamide is tasteless, whereas to the remaining individuals this substance is intensely bitter.[27] The ability to taste phenyl-thio-carbamide has been found to be no index of general taste sensitivity. However, since taste blindness is inherited according to the Mendelian laws and is easily determined, this characteristic is frequently used in studies of human genetics. Furthermore taste blindness, like color blindness and anosmia, holds potential value as a starting point for basic research in sensory mechanisms.

Warden LaRue from Black Star

As true taste is fairly well understood, a few relationships between taste and chemical constitution are known. Thus a substance must be soluble in water in order to be tasted (although many water-insoluble materials have pronounced flavors). A sour taste depends mainly upon the presence of hydrogen ions. Many salts of lower molecular weight taste salty; those of higher molecular weight, in general, bitter. But points of confusion here outnumber elements of order. Thus, substances with totally dissimilar chemical nature, such as saccharine and sugar, sometimes have like tastes.[28] On the other hand, minor alterations in molecular structure may radically change taste.[29]

With regard to the effect of chemical constitution upon flavor, it is noteworthy that imitation flavors frequently bear no chemical resemblance whatsoever to the natural flavor they simulate. It is also striking that many flavor substances contain only the elements carbon, hydrogen, and oxygen. A few important flavor principles also contain sulfur or nitrogen, or both. The other approximately 90 chemical elements, surprisingly enough, rarely occur in the molecules of substances of importance in the field of flavor.

Skin Game

Would mankind be better off if bereft of the cutaneous or skin senses? Pain is a cutaneous sensation. Of all experiences, pain is the one that most strikes terror to the human heart. Although much of medical research has always been devoted to the conquest of pain, success so far is at best partial. In addition, cutaneous senses make extremely hot or cold environments unpleasant, and render tight clothing and crowded subway cars uncomfortable. But all of these irritating cutaneous sensations are in fact indispensable as safeguards against harmful effects, and therefore are necessary to self-preservation. Pain warns against trauma, not only by conscious motivation but also through instantaneous reflex action. Sensations of heat or cold discourage us from exposing ourselves

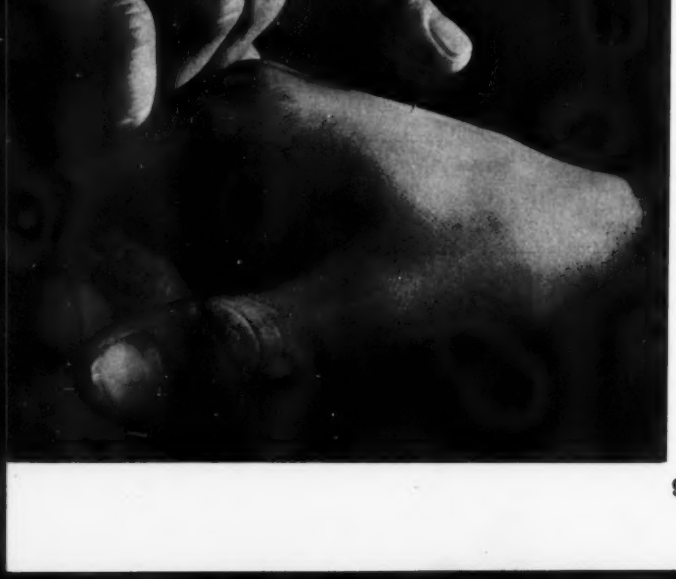
to extremes of ambient temperatures beyond those with which the temperature regulatory mechanisms of the body can cope.[30] The pressure sense warns when constricting clothing cuts off circulation.

But aside from such protective values the cutaneous senses also make definite positive contributions to the conduct of human affairs. Cutaneous sensations underlie the use of tools, and tool techniques are considered to have led to the development of present-day civilization. Man is the only animal able to grasp tools in the manner for maximal utility, because he possesses the unique gift of an opposable thumb. Obviously, however, more than the mere grasping of a tool is required; the implement must also be guided. It is true that the muscle and joint senses suffice for guidance of tools in rough jobs, such as the levering of a boulder with a crowbar, but for the precise handling of tools and instruments basic to modern technology, delicate manipulation made possible by the cutaneous sense of pressure is mandatory.

It might be argued here that man has now left behind him the era of predominant use of hand tools, and that today major technological tasks are accomplished by machine tools. This is true, but nevertheless cutaneous sensations are still the means for making the fine adjustments involved in the operation of machine tools.

But even in the direct observation of phenomena, the cutaneous senses come into play in ways that are sometimes overlooked. Thus it may be noted that the mechanic engaged in removing dents from an automobile fender, and the physician scrutinizing the texture of a patient's skin, both supplement their visual impressions of the surface with which they are concerned by running the palms of their hands over it. Physicians, in fact, make a number of diagnostic observations via their cutaneous senses; for example, condition of the abdominal viscera examined by palpation, internal fluid pressure of the eyeball judged by resistance to fingertip pressure, and even surface temperature differential between the ankle and knee as an index of diminished circulation in the leg.

Black Star



How to Make Sense

Sensory impressions are taken in, from the environment, via the specialized receptors of the several senses. Next, these impressions are carried over nerve channels to the brain and contiguous central nervous system structures. Then, finally, the central nervous system interprets and integrates the sensory impulses, and utilizes them as stimuli to action. Therefore loss of sensory acuity from injury, as by trauma or disease, can occur in any one of three foci: in the sensory receptors; in the nerves that convey impulses from the receptors to the central nervous system; or in the central nervous system itself. Some perspective of the scope of the middle one of these three elements may be gained from the proven fact that a given nerve channel can carry only a single type of impulse. This impulse may vary as to intensity, but not as to nature. Considering now the wide variety of sensory impressions that this article has set forth, the tremendous intricacy of the nervous network becomes apparent.

If one of the trinity of receptor, nerve channel, and brain had to be singled out as the most important element in sensory perception, it would doubtless be the last of these. For example, we have seen that the only means of selectivity in hearing is inhibition or concentration by the brain. It has further been shown that the skill of flavor judges depends much more upon training (accomplished by the central nervous system) than upon initial inherent acuity (a measure of receptor acuteness). A related example of the primary importance of the central pathways in sensory perception may be drawn from blind persons. At first blush, the blind appear to have extraordinary touch sensitivity, as evidenced by ability to read Braille and to do exacting manual tasks entirely by feeling with the fingers. Blind persons also seem to have exceptionally acute hearing and olfactory senses, in that they are aware of environmental sounds and smells that are overlooked by sighted persons. But objective tests of the touch, hearing, and odor acuity of blind persons show that they do not gain in these senses when they lose their sight. Rather the blind improve the contribution of their central nervous system, because loss of sight promotes better conscious concentration on the remaining senses.

Support of a different nature of the paramount importance of the central pathways may be adduced from an animal experiment.[31] Nerve impulses are accompanied by electrical phenomena, and hence passage of impulses along a nerve may be detected by means of electrical leads. When the auditory nerve of a cat isolated in a soundproof room is thus tapped, and the nerve impulses so sidetracked are transformed into sound and amplified by means of standard electronic equipment, words addressed to the animal emerge from the loudspeaker as intelligible speech. This demonstration shows that the lower animal is able to receive human speech through its ear mechanisms, and also to transmit the resultant impulses along nerve channels. But speech is essentially meaningless to the central nervous system of the cat. Therefore it is this last phase alone of sensory ability that sets man apart from the lower animal.

(*Continued on page 106*)

The Engineer and Security

The Only Real Security Lies in Developing Our Ability to Cope with the Unexpected and the Unpredictable through Exercise of Originality and Ingenuity

By LUIS DE FLOREZ

THERE was a time when the world produced huge, powerful creatures who owed their existence and survival to sheer strength and personal armament. In the quest for food and the demand for living space, they were supreme in their time; yet all that remains of these formidable denizens today are the fossils that tell us of their existence in history.

In our present age we find the same inexorable laws of survival, the same struggle for a place under the sun, and more competition than ever before in the same world of limited food and infinite appetites. We find the same need for might to overcome man's enemies. Yet man, by comparison a physical weakling, has become lord of creation, and his species overruns the earth, tolerating the existence of other beings or employing them to his use. Why?

We all know the answer which, basically, is simple enough. It was, by some mysterious process, the development of the intellect in the *genus homo* which brought him not only the ability to survive, but the power to become undisputed master of the world with only one real adversary — himself. Man is master of the lion and of the germ — or at least many germs: he has harnessed the world's energy to his use: he has conquered the air and the sea for transport and the ether for communication: he has performed miracles in biology and chemistry to enhance his food and combat disease: he has ferreted out the secret of atomic energy and, even now, he is casting his eyes toward the exploration of interplanetary space.

All this world of wonders and adventure, with even greater promise in the years to come, has been wrought by the development of the intellect in man. Our precious heritage is to use or misuse, to cultivate or to neglect, to enrich or destroy the world — in short, to survive or perish — through further developments of human intellect in the broad sense of the term. In our day and age when the struggle for survival is centered within mankind itself, engineers are perhaps more fortunate (and for this reason have greater responsibilities) than most of our fellow men. In the study of nature's laws, we have discovered and have come to understand the reasons for things which remain a mystery to so many others. We have been given a glimpse of reality and the opportunity of planning our actions in the world of things as they are. By virtue of our training and knowledge, we have acquired the best of preparation for life's great adventure and for the changes which are to come. It lies with us, individually, to choose between the blazing of new trails and the following of beaten paths, insulated by routine and accompanied by boredom. In our quest for an interesting and fruitful career we might well ask ourselves: "What constitutes an engineer worthy of the name? What are his attributes and what is his role in our society?"

A conventional definition might be that an engineer is one who has studied the sciences and applies the knowledge gained to the solution of the problems of industry. He has been described, somewhat less formally, as a man who can do for $1.00 what anyone can do for $2.00 (or for that matter what any government agency can do for $10.00).

It is doubtful whether we can, or whether we should even try, to concoct a satisfactory, or adequate, definition in a few words, no matter how well chosen they may be; for the engineering profession encompasses virtually every phase of human activity and requires men of widely different characteristics and interests.

We do know that an engineer must understand and accept the fundamental laws of nature; that without technical knowledge in his field and without acumen to apply his knowledge he would be useless; that without common sense and some measure of philosophy to guide him he might prove to be a menace. We know that he has just as much need for a sense of humor and a knowledge of human nature as anyone else in this world, that failures will come to him, unexpectedly and unwelcomed, and that such failures do not spell defeat, but are a part of the ingredients of successful accomplishment.

Our technical schools and colleges teach engineering subjects and teach them well, but their graduates are not necessarily engineers, in the real sense of the word, merely because they have completed prescribed courses. Every effort is made to teach students the principles of engineering and some of their applications, and to illustrate current methods and procedures; but it is neither possible, nor even desirable, to attempt to drill a student in sufficient detail to prepare him for all the problems and all circumstances which he will meet in his future career. If, by any stretch of the imagination, such a thing were possible, the result would surely turn out to be some sort of animated encyclopedia, with a long white beard, operating from a wheel-and-wicker chassis.

As it is, the growing volume of technical material which must be taught in four years, together with the economic pressure to prepare graduates to jump into specific jobs straight from school, tends to keep a student so busy absorbing technical knowledge that he has little time left for original thinking.

To conserve time in the crowded curriculum, it is often necessary to resort to the expediency of presenting students with standard problems and of discussing their solutions, instead of giving them time to work out the answers for themselves. Instruction of this sort illustrates and teaches the method very effectively but we must always remember that it does not tend to develop the type of thinking which must color our work in later life and provide the basis for creative accomplishment, nor does it promote the exercise of mental functions in the manner which they will be called upon to perform in our life's work.

Such practice is somewhat analogous to shooting clay pigeons as a preparation for actual bird shooting in the field. Trapshooting is effective in teaching the handling of the gun and how to hit moving objects, but we cannot expect the mechanical skill we learn in this way to make us equally expert gunners under field conditions. Instead of stereotyped targets as in the first case, we are now confronted with targets of independent initiative over which we exercise no control and whose action and vagaries we cannot predict; whereas the objective in the first case is to make a score, in the second case it is to bring home the proverbial bacon.

Methods, no matter how well taught, are not an end in themselves: they are but tools which must be adjusted and intelligently directed. To be successful as an engineer one must constantly exercise the characteristic which has been most responsible for the progress of mankind from the Stone Age to our present state. The quality which we most need to solve the formidable problems of the future is ingenuity.

There are some who believe that the exercise of ingenuity is the prerogative of the inventor. If that be true, then all of us who survive in competition must be inventors of something sufficiently important to keep us alive. In actual practice, for which we prepare in technical training, the problems which confront us are seldom clear-cut or subject to solution by mere routine procedure. We must seek not only *a* solution, but the *best* solution which requires exercising our ingenuity as well as all our knowledge. It is the constant possibility – the constant hope – of finding new and better solutions which makes the engineering profession interesting and exciting. To do things simply and with less effort, to conserve energy and materials, are goals which are not attained by mere recourse to handbooks, slide rules, or reliance on common practice. We must keep our wits just as sharp in engineering as we would in proverbial horse trading.

There was a man once who calculated he needed a 50-cubic yard concrete foundation under a support and proceeded to blast out some 50 cubic yards of solid rock to put it in. He was a graduate of one of our best engineering schools, but he was not an engineer. He was merely a de luxe model robot.

Contrast this mentality with that of another man who, as a boy on the farm, found himself confronted with what was probably his first engineering problem – the shooting and disposing of an old and ailing horse. None of the farm hands could agree on how they would transport the horse, when dead, from the barnyard to a prepared pit for burial. The boy solved the problem by leading the horse gently to a position just the right distance from the pit and toppling him over into it just as he fired the merciful shot. He had the mentality of an engineer and later became a distinguished figure in the engineering world – manager of Colts at 25 and director of the world-famed Fabrique Nationale in Belgium before the age of 30. He was the man who as agent for Cramps, shipbuilders, sold a fleet of torpedo boats to the Russians during the Russo-Japanese War. To effect the sale, he had to devise a way of getting the craft to the Far East. He arranged to build them in short sections, put them on flat cars, and ship them by rail across Siberia to Port Arthur. When the Russians argued that this would not work, as the sections in their cradles would not pass through the tunnels, he turned the sections keel up, and they just cleared through. He also gained fame as the man who introduced the Wright brothers' airplane to the world, as their agent in Europe. When the Wrights found difficulty in financing and selling their brain child in their own country, it was he who, by skillful management and vision, convinced the skeptical world that the heavier-than-air machine was a reality by dramatic demonstrations. He was a man who never received an engineering degree: he had to acquire his technical knowledge the hard way. Nevertheless, he learned to use all of his fertile intellect and give rein to his ingenuity and resourcefulness to become an engineer in the best sense of the word.

Just as "the habit does not make the monk," neither does the certificate make the engineer. Some spark of originality, some creative spirit, must be added to technical training to achieve the result. In our daily lives and pursuits, we have but to look about us to find ourselves surrounded by products of human ingenuity – devices which have resulted from the most subtle and clever thinking. The familiar and now prosaic household objects, such as the telephone, radio sets, refrigerators, pressure cookers, vacuum cleaners, electric shavers, and virtually everything we use have some original feature (some touch of the unusual) which gives them a preferred place in competitive development.

Power plants, automobiles, aircraft, cash registers, business machines, tunnels, bridges, and, in fact, all the extraordinary fruits of modern engineering, at our every hand, have resulted from creative thinking based on original concepts, using past experience and past accomplishments only as guides to keep within the fundamental physical laws. What we know of the universe, and especially our concepts beyond earthly range, has come from the ingenious application of mathematics and physics. What we know of atomic structure and forces has come from incredible ingenuity in developing methods by which we can observe, measure, and control the action of infinitesimal and unseen particles of matter.

If ingenuity plays such an important part in engineering, we might ask ourselves: Why is it not taught in engineering schools? The answer is that ingenuity cannot be taught as such. It can, however, be developed, it can be encouraged, it can be stimulated. Some people come by it naturally; others must have it awakened in them by competition and unsatisfied desire. It is an intangible quality of mind which will guide us around obstacles and lead us to our objective

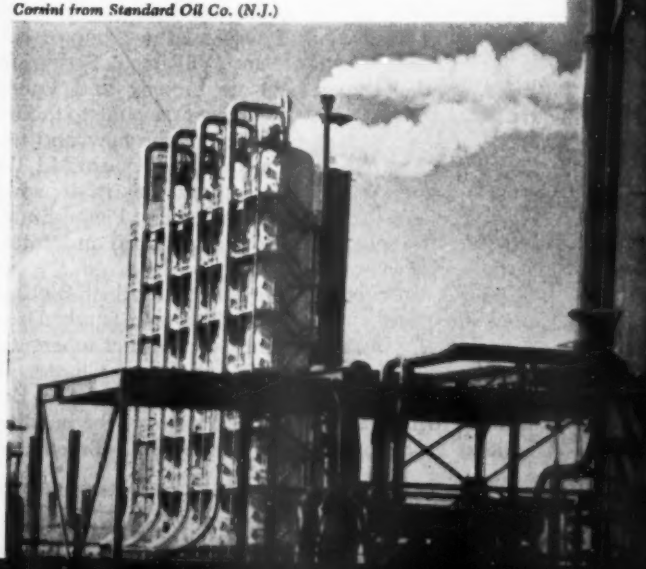
in new and unexpected ways. Ingenuity involves an independence of thought which seeks to do things differently, and constantly proves that the well-beaten path is not necessarily the right one. When things are done differently, something new seems to be added to man's knowledge or convenience.

Convention in design and tradition in practice have a way of freezing or channeling thought so that we tend to continue using the same old method, building the same kind of machines until someone starts an entirely new tack. By habitually scheming to do things differently, we keep our minds open and flexible, ready to progress to new and better ways when the opportunity arises. Thus, someday, we may be fortunate enough to be the one to start the new trend, and we may be the one to be thanked in the future.

In the early days of petroleum refining, it was common practice to have the controls of a process located on individual units, such as the pumps, furnaces, and coolers, together with gauges and dials to indicate their individual performance. To operate such a process, one had to keep on the move, from one place to another, and never had opportunity to really be able to co-ordinate the operation as a whole. Instead of sending the operator scurrying around to the controls, why could not the controls be brought to the operator? There were objections, of course. The operators should watch individual operating units for failure, the operators should be kept on the move to keep them alert, and other equally hollow arguments advanced by the satisfied.

At the first opportunity, I built a cracking plant with central control, bringing all the operating controls and pressure and temperature readings into one room and grouping them on a panel. The new job of control man, to operate the process as a whole and to be responsible for the over-all result rather than the functioning of any individual unit, was created in 1916 when central control was first applied in oil-refinery operation. The then new idea worked so well that today central control is common practice in refinery design, as it is in other industries. This rather basic change required no invention but merely a much needed departure from tradition.

(Continued on page 110)



Cornini from Standard Oil Co. (N.J.)

William T. Sedgwick, Biologist

One of Technology's Great and Inspiring Teachers Was Also an Author and Orator of Note, and a National Leader in the Field of Public Health

By JAMES A. TOBEY

About 40 years ago it was the edifying custom at M.I.T. to assemble the freshmen into Huntington Hall, in the old Rogers Building on Boylston Street, and expose them to more or less fervid talks on the advantages and allurements of the several courses then available at the Institute. These somewhat cursory descriptions of 14 different branches of engineering and science were intended to assist a teen-age student, perhaps with an immature mind, to make an intelligent decision as to the course of instruction he would follow at the Institute. It is not surprising that there was some subsequent falling by the wayside.

Since engineers and most of the mentors of engineering were then, are now, and probably always will be among the least articulate and the least eloquent of professional groups, these lectures usually were more prosaic than inspiring. They were, of course, valuable as factual presentations, and occasionally they were interesting, but only rarely were they exciting or stimulating. There was, however, one notable and outstanding exception.

When the seventh in this series of discourses was to be given in the year 1911, there strode briskly upon the stage a rather tall, handsome, and distinguished-looking individual in his middle fifties, plainly but neatly dressed, with a couple of gold keys dangling from his watch chain. His rather luxuriant gray hair was parted in the middle, he wore gold-rimmed spectacles, and his visage was adorned with a drooping gray moustache. To the callow youth of his audience he had the appearance of another eminent and benevolent professor who might be expected to contribute to the customary tedium, and then pass and be forgotten like the rest. It was rumored, too, that he was to talk that day on the unaesthetic subject of sewage disposal.

Callow youth was in for a pleasant and startling surprise. From the moment that this gentleman began to speak, his uneasy audience started to sit up and take notice. By the time that he was well launched in his talk, they were literally sitting on the edges of their chairs. Not a foot shuffled in this somber hall where the feet of restless students had scraped and shuffled since Huntington Hall was first used; not a cough disturbed the rich, smooth flow of words. Here, at last, was something worth listening to. Here indeed was a speech that was a masterpiece both of form and substance and an inspiration to all who heard it.

As one of those who sat enthralled on that occasion so many years ago, I do not, of course, remember the precise words uttered by the speaker. They were, however, something like the following quotation, taken from a published contemporary address:

> Human life was probably never more interesting or more exciting than it is today. Those of us who were born in the middle of the last century have been fortunate, for we have witnessed the conquests of Darwinism, and the genesis of the theory of evolution, the rise of anthropology, and the victories of the germ theory of disease. Think of it for a moment — the theory of gravitation, the theory of evolution, the theory of infection! What a privilege to have lived while these were debated and finally accepted as the basal theories of science.
>
> And yet, those who are now coming on the stage are likely to enjoy lives even more interesting, for not only will new knowledge arise and new theories press forward, but the application of the knowledge already at hand will, of itself, suffice for many lifetimes. These applications may be summed up under the general heading of a new physiology or a new behavior of mankind. And in this work the biologists and sanitary engineers are clearly to be the experts and guides. It behooves us therefore to lay broad, deep, and strong the foundations upon which these newer activities must be built, and it is for this purpose that we here at the Institute are working together, today and tomorrow.

At the conclusion of this remarkable address the spellbound audience came out of its trance and burst into loud and prolonged applause. The students had not begun, as usual, to gather up their lares and penates before the lecture was over, so that they could escape immediately from the room. This time they sat and continued the ovation for several minutes in obvious enthusiasm.

The recipient of this well-merited tribute from one of the most critical of all audiences, a group of college freshmen, was Professor William T. Sedgwick, Head of the Department of Biology and Public Health. Ever since 1883, when he first came to the Institute as an assistant professor of the new and unfledged science of biology, he had been one of M.I.T.'s most unforgettable characters, and this in a period when the dingy old Rogers, Walker, and Pierce Buildings in Boston were replete with colorful and unforgettable characters.

Who could forget the brilliant President Richard Cockburn Maclaurin, the dignified and hearty Dean Alfred E. Burton, the patently cynical but inherently kindly Professor Arlo Bates, Professor Charles R. Cross, '70, and his little mannerisms, Professor Edward F. Miller, '86, and his narratives of the bursting boilers, Professor Charles B. ("Buller") Breed, '97,

Ralph Adams Cram and his pipe, the black-bearded Frank M. Gracey of drawing, and the white-bearded John Ritchie, Jr., of public relations?

Among these, and many others, Professor Sedgwick was distinguished not merely as an orator, but as a human person. In addition to his unique ability as a speaker, he was an exceptionally able and inspiring teacher, a national leader in the developing field of public health, America's foremost epidemiologist or sanitary detective, an author of note, and a zealous and devoted public servant. Most of all, he was both a gentleman and a scholar.

In an era when the art of gentility was rapidly becoming a lost art, Professor Sedgwick was one of the few who were entitled to the honorable title of gentleman because he was invariably courteous and considerate, patient and reasonable, sympathetic and helpful, gracious and honorable. He seemed never to lose his poise; he did not get irritable or sarcastic; and he was not contentious or truculent. On occasion he could be stern and he was often militant in a good cause, but in all his dealings with others he was strictly fair and impartial. These are qualities which endear a man to his students as well as to the public in general.

Once when I was floundering in a chemical laboratory, hopelessly confused by some minor but, to me, abstruse problem, a dour assistant professor came strolling by. He watched my struggles for a few moments, remarked casually, "You don't seem to understand this, do you?" and walked away. Now, Professor Sedgwick might have made the same remark, but he most certainly would have added, "Let me help you." He was one of those who realized that the function of a teacher is to teach. He also appreciated the fact that instruction consists not merely of cramming a mind full of facts, but in the development of that mind to utilize the facts in a sensible and efficacious manner, and to think. Professor George F. Swain of the Civil Engineering Department had the same peculiar idea, but unlike Sedgwick he often became impatient and sarcastic about it.

Professor Sedgwick was born in Connecticut in 1855 and graduated from the Sheffield Scientific School at Yale in 1877. He then entered the Yale Medical School, completing one year of dull lectures in a course devoid of any laboratory work or practical demonstrations. Thoroughly dissatisfied with this type of instruction he left at the end of his second year, having happily obtained a fellowship in biology at the newly established and brilliantly administered Johns Hopkins University in Baltimore. There he received his Ph.D. in 1881, a much more honorable degree at that time than the M.D. which, in the words of President Eliot of Harvard, usually was awarded to "a rougher class of young men than any professional students of similar age." Charles W. Eliot, it may be recalled, was a professor of chemistry at M.I.T. when he was appointed president of Harvard University in 1869 at the tender age of 35.

After serving for two years – first as assistant and later as associate in biology – at Johns Hopkins under the aegis of the unforgettable H. Newell Martin, Dr. Sedgwick was summoned to M.I.T. by one of his former teachers, General Francis A. Walker, its President, and installed in a cubbyhole in the old Rogers Building as assistant professor of biology. His first plan was to emphasize the courses in the biological sciences as a desirable prerequisite to the study of medicine, a study which was undertaken in those days without any preliminary preparation whatever. The idea was good, but the prospective physicians were not in the least attracted to it: Instead of flocking to such a worthwhile course, they stayed away in droves. With much prodding from the indefatigable President Eliot, medical education finally was reformed in this country, although not completely until well after the turn of the century. Today it is probably the best in the world, but until about 1910 it was frequently inadequate and inept.

Although disappointed by the indifference of the medical students of the times, Professor Sedgwick at once turned to other fertile fields of endeavor and proceeded to make M.I.T. the leader in environmental sanitation and public health in the United States. In 1888 he was appointed consulting biologist to the Massachusetts State Board of Health, organized in 1869 as the first state board of health in the country but in the eighties concerned more with lunacy and charity than with hygiene and sanitation. An experiment station for investigations of improved methods of sewage disposal and water purification was established by the State Board of Health at Lawrence, Mass., under the sponsorship of an eminent hydraulic engineer, Hiram F. Mills, and with Sedgwick and Professor Thomas M.

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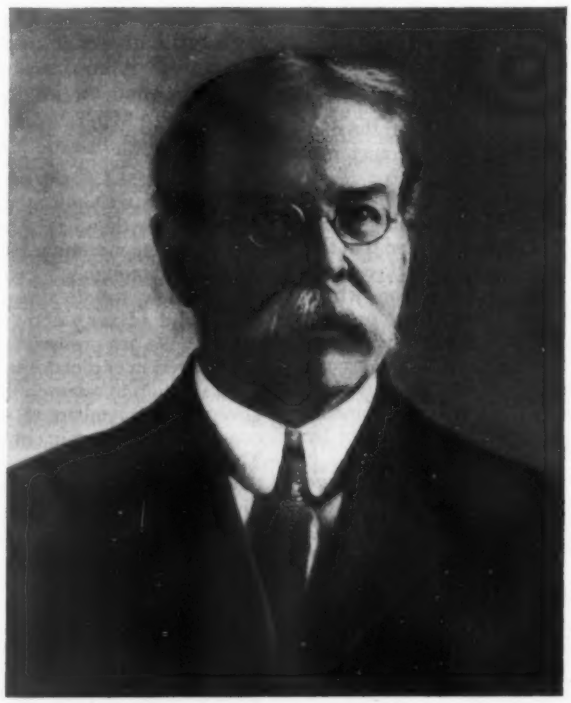

William T. Sedgwick
Head of the Institute's Department of Biology and Public Health, 1907–1921

THE INSTITUTE GAZETTE

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Corporation Deliberation

National Interest Guides Policy of Keeping M.I.T. Facilities Intact and in a State of Readiness, Reports President Killian.

THE uncertain tension in international affairs, with the cold war already having been precipitously warmed up in Korea and Indo-China, was reflected in the annual report of James R. Killian, Jr., '26, President, to the M.I.T. Corporation at its meeting in Cambridge on October 2. The danger of over-committing M.I.T. Faculty and physical facilities prematurely was clearly recognized by President Killian who reported that the Institute would continue its normal functions of education and research as the best method of contributing to national security under existing conditions. By such a policy, Dr. Killian stated, the Institute would best be in a position of readiness to assume high-priority assignments in the interests of n tional defense when, and if, aggression cannot be stemmed by men of reason working toward international peace. Said President Killian in his report:

No educator contemplating the present world scene and its inherent hazard of another catastrophic war can fail to be deeply disturbed and perplexed by the difficulties of setting any true course. The half-light in which we live obscures the road ahead and dims the clarity of any policy or long-range plan. It is like driving in the twilight: the dim light makes it hard to see and the headlights are much less effective than they are in total darkness.

In presenting my annual report at this time, I do so with the awareness that our programs and our planning at the Institute are subject to change without notice, and that the only policy that we can be certain is sound is to keep ourselves in a state of readiness to serve our nation, which must now mobilize its might as the surest way to prevent a war as well as to maintain the essential condition for our defense. I can report to you with confidence that all groups at the Institute share in this feeling of responsibility. Underlying all of our policies and planning is a clear commitment to be guided by the national interests and not by self-interest.

Keeping ourselves in a state of readiness means that we should keep our program as flexible as possible. We should try to avoid commitments that might later prove to have low priority. We are trying to hold our staff as nearly intact as possible so that they may be effective as a team in carrying on our present program and in attacking any emergency programs that we may later be asked to undertake when the need might be much greater.

Educational Policies. Urging that the United States maintain its educational facilities in as vigorous a condition as possible, President Killian clearly recognized that we should be prepared to drop normal operations and mobilize completely if called by national policy to do so. The past history of the United States points to the wisdom of such a policy. Recalling this country's policy in the past, Dr. Killian said:

During World War II, we in the United States ran a risk in largely discontinuing education for professions essential to defense — a risk that both England and Russia refused to take even in the face of invasion. I am hopeful that the present studies of the National Security Resources Board will result in a courageous man-power policy that gives adequate weight to such considerations and that charts a clear emergency course for our universities and their students to follow. Whatever this policy may be, the universities can and will adjust to it. Meanwhile schools training men for such essential professions as science, engineering, and medicine have a responsibility to maintain a high degree of educational effectiveness.

The future of our country also depends upon our holding fast as long as possible to those aspects of education which inculcate a sense of the first-rate as expressed in such imponderables as good taste, high standards, and high ideals. It is all too easy to think of these as nonessential.

Research Policy. The mobilization of scientific resources today for national welfare is on a much firmer basis than was the case prior to World War II. Large numbers of scientists are now familiar with military problems and requirements, and effective liaison between military and research groups is currently in effect. This state of affairs is an important factor in determining M.I.T.'s policy, and with these considerations in mind, President Killian suggested:

. . . that M.I.T. should continue its basic educational and research activities as uninterruptedly as possible, especially since they bear directly on national defense. We can make our maximum contribution to national security by doing thoroughly what we already have undertaken. As you know, we are already carrying a heavy load of research and advisory activity in connection with national defense. We are prepared to continue this with vigor, or, as the need may dictate, to expedite and to expand it.

In addition to research they conduct on campus for the government, members of our staff have been serving as consultants to government on a wide variety of problems. The magnitude of this service is quite beyond anything that took place prior to World War II, and provides another illustration of the resources of man power and ideas which are present in this institution.

During the past several years an interesting new consultive technique has been developed and employed here and elsewhere to help the government solve complex problems. Let me cite a specific example. Two summers ago the Atomic Energy Commission needed expert counsel and imaginative consideration of a highly technical and strategically important problem. Instead of setting up a research laboratory or a new research group to deal with it, A.E.C. representatives came to M.I.T. and asked if we would assemble a representative group of first-rate scientists and

engineers to spend three or four months intensively studying this problem for the purpose of appraising present ideas and charting a future course of action. The group was to undertake no laboratory research. It was to serve rather as a panel of experts and was to be so briefed and organized that they could be uninhibited in their thinking about the problem. This group, which came to be known as the Lexington Project, was organized under these conditions. A group of first-rate men from both industry and a wide variety of educational institutions was brought together, and spent the summer living with this problem and thinking about it in a free-wheeling manner. The results were good, and the A.E.C. had in its hands an evaluation and a program which it hardly could have obtained in any other manner.

So successful was Project Lexington that its formula has now been duplicated several times with new groups assembled to study problems of other government departments. In each instance the results have been highly valuable. A new order of civilian ingenuity and imagination has been brought to bear upon military problems, and the government has had the benefit of some of the best minds in the nation. It has had the benefit of these minds, and this is important, without unduly disturbing their normal educational or industrial activities. The groups have all been assembled for relatively short periods of time, and a deadline set beyond which they would not go. The men in the groups then dispersed and went back to their normal activities.

I cite this type of assistance to our government to illustrate two advantages of the plan. In the first place, it provides a technique whereby our government can have access to the best thinking of our professional people without uprooting them for long periods of time. By bringing them together in these *ad hoc* study groups, the government is able to get sound counsel on complex technical questions. Furthermore, it can get broad thinking about systems, instead of limited thinking about components. Because M.I.T. has a versatile and integrated team, it has unusual competence to do comprehensive "systems" research, and many of our staff feel that this is one of the most important contributions that we can make to defense.

The second advantage of this type of project is that the men who are participating in them can lend their services to the government without upsetting unduly the programs of the institutions to which they are permanently attached, or for that matter without unduly disrupting the professional activities of the men themselves. Still another advantage of this kind of arrangement is that it builds a cadre of informed professional people in this country who know what the government's technical problems are in certain areas that otherwise would be kept from them, and therefore who are more readily available further to assist the government if an emergency makes it necessary.

Government- and industry-sponsored research projects, together with projects such as the one I have just described, are means by which we can make a direct contribution to the national security and at the same time continue to perform our basic and fundamental jobs of educating a steady stream of young people and of advancing the boundaries of knowledge.

Year in Review. In reviewing activities at M.I.T. during the period between October, 1949, and October, 1950, a good portion of the President's Report dealt with the report of the Faculty Committee on Educational Survey, which was summarized in the November, 1950, issue of The Review, and, for this reason, will be omitted here. The Faculty and the Administration are in accord that M.I.T. must have superlatively good undergraduate teaching – the best that can be found. In accordance with the recommendations of the survey, the Faculty has appointed a Committee on Undergraduate Policy, with Professor Walter G. Whitman, '17, of the Department of Chemical Engineering, as chairman. This important new committee has started its work by a restudy of the first-year curriculum and the integration of those Faculty groups responsible for undergraduate instruction.

The President's Report contained a review of the increased activity of the Summer School, which is omitted here since the substance of this program was included in this publication last month.

In a review of residential facilities which are being expanded for students and staff members, the inauguration of new facilities for education and research, progress of the Development Program, and special needs of M.I.T., the president's annual message recorded the following:

Towards a Residential College. One of the most important additions to our facilities during the year was made through purchase of the Riverside Apartment Hotel on Memorial Drive. We have started this summer converting this building to a dormitory that will ultimately house some 500 students. This, together with the new dormitory which was finished last year, gives us within a year nearly 1,000 new accommodations for students, more than doubling our permanent dormitory facilities. This brings us closer to our objective of having dormitories adequate to house those students who wish to live in them.

When the Riverside Apartments are in full use as a dormitory, we will be able to provide housing for approximately two-thirds of our student body, if we include the temporary barracks, Westgate, Westgate West, and the fraternity houses. This additional housing means a notable improvement in our environment and in our opportunity to provide a more rounded educational program and community life for our student body.

With this additional housing available we were able this fall to take care of all freshmen who wished to live in dormitories. By gathering a large proportion of our freshman class together on the campus, we can better promote adjustment and morale, and strengthen the educational influence of our community life.

New Facilities. Blueprint preparation, ground breaking, and dedication ceremonies have continued to mark the progress of our Development Program. The Hydrodynamics Laboratory and Towing Tank, begun last year, are now in use. The 12,000,000-electron-volt electrostatic generator has been substantially completed. Dedication of the Charles Hayden Memorial Library took place in May . . .

Construction was started this summer on the Sloan Metal Processing Laboratory. This will provide much needed new facilities for education and research in metallurgical science as applied to basic manufacturing processes. Named in honor of Alfred P. Sloan, Jr., '95, whose generosity has made it possible, this new building will enable the interdepartmental metal processing laboratory to enjoy superb working facilities.

A new biology and food technology laboratory, to be called the John Thompson Dorrance Laboratory, in honor of the late John Thompson Dorrance, '95, has been made possible by a grant from the Campbell Soup Company, and the design of this structure is nearing completion. It is our hope that we will be able to start construction on this important addition to our science facilities this year . . .

Of major importance to the development of our college community and our broader educational program will be the auditorium and chapel for which funds have now been received from the Kresge Foundation. The addition of an

General view (left) *of the Boston Stein Club Map Room in the recently completed Charles Hayden Memorial Library during ceremonies on October 24 when the map room was dedicated. Typical examples of maps and atlases which are available in this well-equipped room may be seen on the walls and the tables.*

M.I.T. Photos

Most prominent feature of the recently dedicated Boston Stein Club Map Room is the six-foot orographical globe made in England for the Institute, and presented by Harry H. Young, '91. The globe is equipped with a plastic meridian indicator and is fully color coded to indicate sea depths and altitudes of significant land masses. Present at the dedication ceremonies were (left to right): *Vernon D. Tate, Director of Libraries at M.I.T., Myer L. Alpert, '22, President of the Boston Stein Club, Mr. Young, and Oscar H. Horovitz, '22, Club Vice-president.*

auditorium and chapel to our campus will carry M.I.T. another long step forward in its program of increasing emphasis on community, cultural, and spiritual activities.

The community life of the campus has also been aided by the addition this past year of a new student-faculty room, where students and Faculty can meet under informal conditions. This room was made possible by the Development Program, and designed by one of the student members of the Student-Faculty Committee, so that its purpose of stimulating a community spirit has been served from the very start.

The student-faculty room is for general use. In addition, we are slowly providing much-needed new rooms for seminars and extracurricular meetings where students and Faculty can get together in attractive surroundings. This June a dedication tea marked the opening of the Dugald Caleb Jackson Room, a room of modern design, beautifully equipped to serve for seminars, conferences, and special meetings of the Department of Electrical Engineering. I might mention here that the new Metal Processing Laboratory is to have a penthouse "common room" above the fourth floor, for the use of all students and Faculty members. Equipped with a complete kitchen and dining facilities, the room will make possible social occasions which will supplement and enrich the formal contacts of the laboratory and classroom.

The progress we have made this last year in adding to our facilities brings us to within sight of reaching our goal of replacing inadequate facilities with modern ones, and of exploiting new scientific and technological opportunities. An outstanding need yet to be filled is for a new build-

(*Continued on page 118*)

Cartographic Library Dedicated

In the present tumultuous world an accurate knowledge of geography is essential to an understanding of the course of events. In the new Charles Hayden Memorial Library, dedicated in May, 1950, a choice ground-floor location overlooking the Charles River was selected for a new kind of map library intended to provide students, Faculty, and research workers with superb facilities for the use of maps as a medium of world understanding, and at the same time to contain all needed resources for conventional study which would involve maps.

In dedication ceremonies on October 24, Vernon D. Tate, Director of Libraries, announced that the new map room was presented to M.I.T. by members of the Boston Stein Club, which is composed of a group of active Institute Alumni. The most prominent feature of the room is a large orographical globe which was especially manufactured in England for the Institute. The globe, which is six feet in diameter, is equipped with a mechanism which causes it to make a rotation every two and one-half minutes. The horizontal scale is 114 miles to the inch, while the vertical scale of the relief is 30,000 feet to the inch. The globe is equipped with a plastic meridian indicator and is fully color coded to indicate sea depths and mountain ranges.

The globe is a gift to the library from Harry H. Young, '91, whose extensive personal collection of

American globes and library on cartography and globe making, have been presented to the Institute's cartographic collections. Another major feature of the map room is a large table, measuring 9 by 20 feet, to afford ample space for the consultation of several maps at a time. Storage for over 100,000 maps is provided in cabinets of the latest type. An enclosed case for atlases, gazetteers, books, and periodicals relating to cartography, a light table and various other special items of furniture, together with cork-faced walls and a slot for hanging large wall maps, add to the versatility of the room.

The basic Institute map collection, including two copies of the depository set of 25,000 U.S. Army Map Service maps, together with extensive collections of other government maps, miscellaneous holdings and ancient maps, are being placed on file for ready reference. In addition to its function as a research and working area, seminars, discussion groups, and on occasion, classes will meet in the Boston Stein Club Map Room where the great orographical globe and auxiliary visual aids will be used to augment the usual teaching facilities.

Architectural Leadership

PIETRO BELLUSCHI of Portland, Ore., who has gained recognition as one of this country's foremost architects, has been appointed dean of the School of Architecture and Planning at the Institute, according to President Killian. Technology's new dean will succeed Professor William W. Wurster, '17, who held the position from 1944 until May, 1950.

Dr. Belluschi will join the Faculty of the Institute on January 1, 1951, but will continue his architectural practice in Oregon until all current and pending contracts are terminated. During this period the oldest associates of the firm of Pietro Belluschi, Architect, will form a new partnership to be known as Smith, Richardson, Kotchik, and Allen. The new firm will assist Dr. Belluschi in carrying out his old contracts and will assume new ones on its own behalf. Dr. Belluschi will act as the firm's consultant.

The new dean was born in Ancona, Italy, in 1899, and was educated at the University of Rome, from which he holds the degree of doctor of architectural engineering. He came to the United States in 1923 and carried on advanced studies at Cornell University before starting his career in Portland in 1925. It was then that he joined the architectural staff of one of the oldest and largest architectural firms in the Northwest, which was established in 1906 by the late A. E. Doyle. The name of the firm was changed to that of Pietro Belluschi, Architect, in 1943. Together, the two firms have been responsible for the design of approximately 1,300 buildings, including many of the largest structures in the city of Portland. Dr. Belluschi's firm has been the training ground for many successful architects now practicing in the Northwest.

Dr. Belluschi has contributed a great many articles to professional architectural magazines, and examples of his work have appeared in practically all professional journals in this country as well as in England, Italy, Denmark, and Argentina. He has received awards for architectural excellence from the Committee of Education of the American Institute of Architects, the Architectural League of New York, the Pan-American Congress of Architects, and Progressive Architecture.

Nationwide Pictorial Service

Pietro Belluschi

Dean of the M.I.T. School of Architecture and Planning as of January 1, 1951

In 1934 Dr. Belluschi was American delegate to the League of Nations Institute of Intellectual Co-operation in Madrid. He is a past president of the Oregon chapter of the American Institute of Architects, and was made a fellow of this professional society in 1948. He is a past president of the Board of Trustees of the Portland Art Museum, and has been a frequent lecturer at the Portland and San Francisco Art Museums. In the academic field, he was for a term design critic at Yale University, and has lectured at the Universities of Washington, Oregon, California, and Illinois.

Bates Honors Killian

PRESIDENT KILLIAN was the principal speaker at Bates College on November 4 when four new buildings were dedicated in services which were held in the college chapel.

In addition to making the main address on this occasion, President Killian received the honorary Sc.D. degree. Other prominent persons awarded honorary LL.D. degrees from Bates were: Harold R. Medina, judge of the U.S. District Court of New York; William Webster, '23, Bates trustee and chairman of the Research and Development Board, U.S. Department of Defense; and Lincoln Filene, President and Director of William Filene's Sons Company of Boston.

Building for the Future

WHEN the 277th meeting of the Alumni Council convened at the Graduate House on October 30, members and guests numbering 140 were in attendance to open the season's activities, under the able guidance of John A. Lunn, '17, President of the Alumni Association.

In the business portion of the meeting, new members of the Faculty were introduced to the Council members, new class and club representatives were named, as well as alternates, and changes in class affiliation were reported for 18 former students, nearly all of whom attended the Institute during the second World War.

Professor Emeritus Charles E. Fuller, '92, of the Department of Mechanical Engineering, presented a resolution on the death of John C. Runkle, '88, which was accepted by a rising vote.

Donald P. Severance, '38, Secretary, reported that between May 6 and October 24, 15 members of the M.I.T. Faculty and staff had visited 19 M.I.T. clubs, as far from Cambridge as Manila, London, Brussels, Paris, Oslo, and Mexico City. Recognition has been accorded to two new M.I.T. clubs which have been formed in Hong Kong and Venezuela.

President Lunn then called on Mr. Lobdell for a special message. After referring briefly to his trip abroad this summer and his visits to four foreign M.I.T. clubs, Mr. Lobdell presented to Walter Humphreys, '97, a certificate of honorary membership in the Alumni Council – this presentation being made 24 years and 11 months after the date of his election as an honorary member!

H. B. Richmond, '14, chairman of the Development Program's Committee on Alumni Participation, spoke briefly of the general campaign currently under way. He urged all Alumni who wished to contribute to the Development Fund to turn in their pledges by the end of 1950, since more than $4,000,000 remains to be raised in the Institute's $20,000,000 goal.

Karl T. Compton, chairman of the Corporation, next greeted the Council at its first meeting, in behalf of himself and President Killian who could not be present, spoke about the Institute's current policy in national defense work, and introduced Robert M. Kimball, '33, executive assistant to President Killian, who was the featured speaker of the evening.

In speaking of the Institute's program of building for the future, Mr. Kimball showed that the value of M.I.T. land, buildings, and equipment had risen from $12,500,000 in 1923 to $24,200,000 in 1950. During the same period, the value of dormitories, which stood at $403,000 in 1926, had this past June become $5,500,000. At present, students are moving from the temporary barracks, a wooden structure which formed part of the Radiation Laboratory, to the Riverside Apartment Hotel which is rapidly being converted into a dormitory housing 626 students. When the currently planned dormitory facilities are completed, more than 2,100 students will be able to live in M.I.T.-operated housing units in proximity to the main educational buildings. Mr. Kimball also indicated that the Administration had given some thought to inviting fraternities to build on Technology property west of Massachusetts Avenue where future development calls for expansion of recreational and living quarters. In dealing with student housing, Mr. Kimball stated that the dormitory cost per student varied from $1,630 for the Graduate House, to $7,300 for the recently completed Baker House.

In a school of technology or science, large investments must be made in laboratory equipment. When built in 1938 for a cost of $217,506 the Wright Brothers Wind Tunnel was the last word in units of its type; today's Supersonic Wind Tunnel cost $813,000 – not including equipment. Even maintenance is a sizable item: $688,000 has been spent on refitting the chemistry laboratories since 1916; the mining laboratories were converted recently at a cost of $57,000, whereas $35,000 was spent to consolidate and modernize the steam laboratories.

Emphasis on Teaching

INCLUDED in a selection of some of the great teachers of 1950, in the October 16 issue of *Life* magazine, is Warren K. Lewis, '05, Professor Emeritus, father of chemical engineering, and for four decades teacher extraordinary at the Institute. Many generations of Technology Alumni will heartily endorse this recognition of Professor Lewis who, although officially retired two years ago, continues his effective guidance of the Institute's future chemical engineers. As chairman of the Faculty Committee on Educational Survey, whose report was summarized in last month's Review, Professor Lewis has made substantial contributions in formulating the Institute's future educational policies.

Further emphasis on good teaching is to be seen in a 32-page manual issued to members of the staff this fall. Prepared by a Faculty committee under the chairmanship of Professor Robley D. Evans of the Department of Physics, "You and Your Students" is intended primarily to assist the young instructors to improve their teaching techniques. The manual is not intended as a formula to tell experienced and successful teachers how to teach. Rather it is an effort to distill from their success those principles which have a recognized soundness, and to set these down in an orderly fashion as a starting point for further development and improvement.

M.I.T. Finances

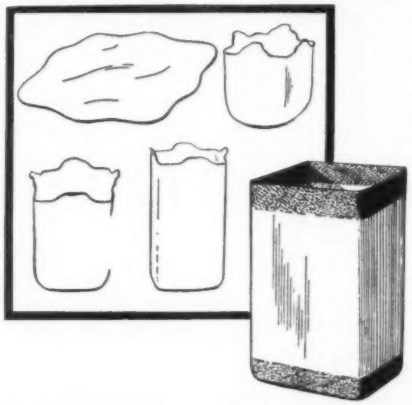
IN his annual Treasurer's Report presented to the Corporation on October 2, Joseph J. Snyder, 2–44, pointed out that the endowment and other funds of the Institute increased from $48,134,000 to $52,383,000 during the year which ended on June 30, 1950. The growth in these resources of $4,000,000 occurred even though substantial withdrawals from funds were made for buildings and other purposes. Approximately one quarter of the increase in the funds of the Institute during the past 10 years took place in the fiscal year 1949–50. At the end of the year, the book value of all investments was $50,994,000 and the market value $57,532,000. Important additions to M.I.T.'s investments included the Riverside Apart-

(*Continued on page 102*)

BUSINESS IN MOTION

To our Colleagues in American Business . . .

The manufacture of a rectangular brass can or shield for a coil would not seem to be a difficult matter. Brass is noted for its easy workability. It can be stamped, drawn, spun, machined, polished, plated, and so on. However, there are a number of brasses containing varying proportions of copper and zinc and sometimes other metals, and Revere furnishes these alloys in various tempers. To take maximum advantage of the goodness of brass, it is essential to specify the metal with due regard to the fabrication processes to which it is to be subjected.



Take the case of these brass cans. They were being produced in ten steps: blanking from strip; draw; anneal; draw; anneal; draw; anneal; sizing draw; trim; tin both ends. This seems to be a simple, easy and conventional method, yet there was a high percentage of rejection due to cracking or tearing of the metal in drawing. There was also an "orange peel" effect, undesirable in appearance, and which sometimes interferes with plating. The chief trouble, however, was tearing.

The Revere Technical Advisory Service was asked to cooperate and obtained complete data on metal specification, annealing time and temperature (1350° F.) and progressive samples. Information and samples were forwarded to Revere Research, which made a thorough study of them, including photo-micrographs to determine the grain size in each of the samples. It was found that the brass strip had too large and irregular a grain structure, and that the annealing procedure accentuated this condition. It was recommended that strip be specified in 70/30 cartridge brass, with a fairly uniform structure and the proper grain size instead of the size being purchased. Then, two anneals could be dropped, and annealing temperature reduced to 1000° F. for one hour. Conclusion: A better product, increased production at less cost, and lessening of the "earing" seen in the sketch of the original samples.

Two things stand out in this matter. One is the advisability of letting your suppliers know how you intend to fabricate or process the materials you buy, in order that they can work closely with you on specification. The other is that suppliers, no matter what they sell, can and are glad to collaborate with you on fabrication problems. Revere is delighted to give its Research engineers such tasks as described here; so are other good firms, not only in metals, but in other industries such as chemicals, wood, felt, plastics, leather, paper and so on. It will pay you to take advantage of the brains of your suppliers.

Incidentally, the term "grain size" is another way of referring to temper, because annealing and working determine grain size. If you would like to know more about this subject, there is an extended, though non-technical, discussion of it in "Fundamental Characteristics of Revere Metals," which will be sent on request.

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THE INSTITUTE GAZETTE

(*Continued from page 100*)

ment Hotel which is being renovated as a dormitory, and the Tech Block which is opposite the main academic buildings on Massachusetts Avenue. Total plant resources had a book value of $24,213,000 on June 30 last and increased $1,970,000 during the year. Resources of the Institute totaled $82,306,000 at the close of the fiscal period.

The volume of operations for the year was $21,470,000 as compared with $23,353,000 in 1948–1949 and $21,036,000 in 1947–1948. The year ended with an excess of expense of $65,667 but the increase in tuition, effective at the beginning of the year, kept the Institute from incurring a much larger deficit. The table which follows shows the percentage distribution of the major elements of income and expense in 1949–1950, in 1948–1949, and in 1939–1940. Income for indirect expenses on research contracts was significantly higher than in 1948–1949 and the expanding housing and dining services on the campus were reflected in the increase in the proportion of total revenues from this source. The greater percentage for general administrative expenses was due to the expenses of the Development Program. Deferred maintenance held over from the war period, along with moving expenses to new buildings, accounted for a large part of the increase in the expense of plant operations. The decrease in revenues for direct expenses on research contracts was offset by a corresponding reduction in expenses.

Distribution of Major Elements of Income and Expense

Item	*Income, Per Cent*		
	1939–1940	*1948–1949*	*1949–1950*
Tuition	48	16	20
Investments	32	6	6
Gifts and Other Funds	7	9	9
Research Contracts:			
For Direct Expense	3	58	50
For Indirect Expense	0	6	8
Dormitories, Dining Services	10	5	7
	100	100	100

Item	*Expense, Per Cent*		
	1939–1940	*1948–1949*	*1949–1950*
Academic	61	21	23
General Administrative	13	8	10
Plant Operation	10	6	8
Research Contracts:			
Direct	3	58	50
Medical and Other	4	2	2
Dormitories, Dining Services	9	5	7
	100	100	100

The total gifts received each year since 1941 are shown in the following table:

(*Continued on page 104*)

"Where are you?" asked a breathless little voice

The little boy who talked to Santa Claus

Direct Line to Toytown—*Billy had seen Santa Claus in the stores. But this was the first time he had ever talked to him by telephone from his home.*

Billy was four and a half and as full of questions as a quiz program.

But the telephone man didn't mind. He had a little boy of his own and he knew how it was. Patiently he kept explaining every step as he installed the new telephone in Billy's home.

Finally the job was done and he was about to make the usual call to the Central Office to be sure everything was in perfect working order.

But it wasn't the usual call this time. For it happened to be just a little while before Christmas and you know how excited a little boy of four and a half can get about then. And the installer and his co-workers at the Central Office had something specially arranged for just such a situation.

"Would you like to talk to Santa Claus?" he asked. "Right now — over this telephone?"

"Ooooh! Yesss!" said Billy.

So the telephone man got the Central Office and asked Santa Claus to come to the telephone if he wasn't too busy making toys. Said there was a nice little boy named Billy who wanted to talk to him. By now Billy's eyes were big as saucers, but quick as a flash he had the receiver to his ear. Next thing he knew, he heard a voice saying —

"Hello, Billy. This is Santa Claus."

"Where . . . are . . . you?" asked a breathless little voice.

"The North Pole," said Santa.

"Is it cold up there?" Etc. Etc. Etc.

They talked for several minutes and there wasn't a happier lad in all the land than Billy. You can just bet those telephone people were pretty happy about it too.

THIS IS A TRUE STORY *of how a telephone installer spread gladness among little boys and girls wherever he found them in the homes he visited during the pre-Christmas period. . . . Nobody asked him and his Santa Claus conspirators in the Central Office to do it. It was their own idea—and just another example of the friendly spirit of telephone people. . . . Wherever they are, and whatever they do, they aim to serve you not only with efficiency but with courtesy and consideration as well.*

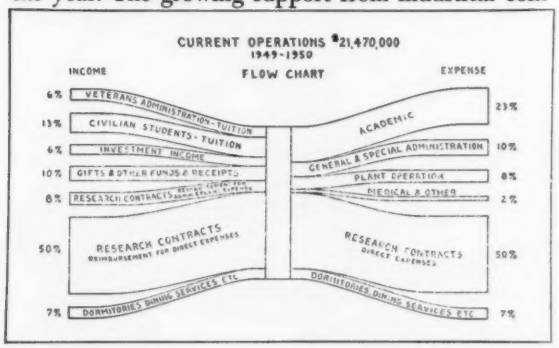
Bell Telephone System

THE INSTITUTE GAZETTE

(*Continued from page 102*)

	Capital Additions	*Total Gifts*
1940–1941	$ 511,949	$ 888,180
1941–1942	534,316	926,897
1942–1943	616,702	884,268
1943–1944	1,132,835	1,367,507
1944–1945	1,245,911	1,736,892
1945–1946	2,042,533	2,549,969
1946–1947	1,945,297	2,382,681
1947–1948	1,381,329	2,191,822
1948–1949	1,900,737	2,536,802
1949–1950	5,064,326	6,528,089

The total of gifts for 1949–1950 does not include pledges to the Development Program received during the year. The growing support from industrial companies continued upward during the year. Important additions were made to funds available for current operations and new laboratory structures.



The Alumni Fund marked its 10th anniversary during the year with 10,631 Alumni contributing $166,280 to the Fund. This brings the total giving to M.I.T. through the Alumni Fund, during the first decade of its operation, to $1,387,237.

Chemistry Curricula Compared

At an all-day meeting at the Institute on January 22, five of the seven members of the Visiting Committee on the Department of Chemistry* attended a seminar at which attention was focused on the teaching of analytical chemistry at M.I.T., particularly at the graduate level. The members of the Committee were joined by members of the Department in thoroughgoing discussions of the present activities, needs, and aspirations of this Department. The Institute's Administration was represented throughout the day by President Killian.

The Committee advised the Corporation that with the completion this spring of an Organic Chemistry Laboratory for research and an Instrumentation Laboratory for undergraduate instruction and research, the physical needs of the Department are now well sup-

(*Concluded on page 106*)

* Members of this Committee for 1949–1950 were: Edward S. Farrow, '20, chairman, Lammot du Pont, '01, Francis J. Chesterman, '05, Kenneth E. Bell, '17, William M. Stratford, '21, Julian W. Hill, '28, and Ralph A. Beebe.

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THE INSTITUTE GAZETTE

(Concluded from page 104)

plied. The laboratories throughout the Department have been modernized and the equipment is adequate. There exists a real need for a large lecture room, but this is not a problem of the Department of Chemistry alone.

The staff of the Department of Chemistry is well qualified, enthusiastic, and flexible; and it is developing and using new and apparently most worth-while techniques. Two recent innovations include: the presentation by graduate students of so-called "propositions" to replace the oral part of major examinations in organic chemistry, thus encouraging critical reading and original thinking; and the use of seminars in organic chemistry to give the student added experience in speaking and writing.

The American Chemical Society has been evaluating the curricula of the chemistry departments in the various graduate schools of the country. In this evaluation, the Institute's Department of Chemistry occupies a most gratifying position.

ALL EXPERIENCE IS OF CHANGE

(Continued from page 90)

But perhaps an even more important contribution of the brain to the sensory sequence of events is integration of impressions received from different senses, in the appraisal of a single phenomenon. An example, again drawn from the sightless, will make this clear. A blind man readily distinguishes between a cube and a sphere by feeling them. The sighted person easily makes the same distinction with his eyes. But when an individual who has been blind from infancy regains his sight and is shown a cube and sphere without being allowed to touch them, he cannot tell which is which. This fact demonstrates that the integration of visual and tactual impressions of form is not inherent, but rather is achieved in the central pathways through experience and training.

In prospect then, what avenues hold most promise open to mankind in enhancing technical usefulness of the human senses? Better basic understanding of sensory mechanisms, particularly of the chemical senses, is sorely needed. Certainly hearing aids should be improved until they are at least as helpful as modern spectacles. Improved aids for the chemical senses would be of value for technical activities, although whether they would be desirable for everyday use is a question.

But the greatest immediate opportunity for improving sensory utility lies in improvement of the central pathways, through intensive training of perception. During World War II, it was found that an individual with good eyesight, and thorough acquaintance with the appearance of enemy aircraft, could nevertheless by training improve at least fivefold his ability to identify airplanes from brief and distant glimpses. This

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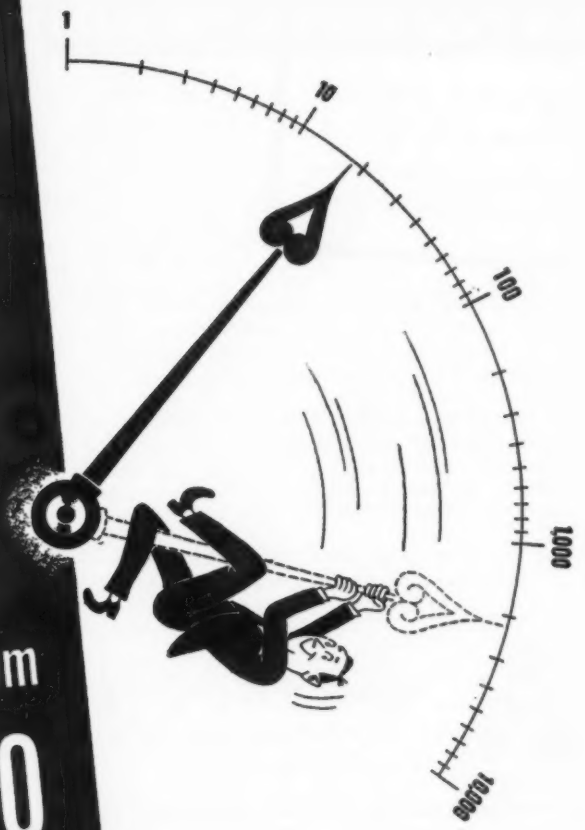
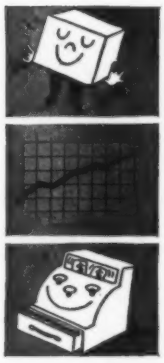
If You Dropped Your Operating Pressure

by factors ranging from 100 to 10,000





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ALL EXPERIENCE IS OF CHANGE

(*Concluded from page 106*)

article has mentioned evidence indicating that the other senses are similarly amenable to improvement by educative processes. Therefore it is in realizing the untapped potential of sensory experience, through training of perception, that man finds his greatest opportunity to improve the usefulness of his senses.

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THE ENGINEER AND SECURITY

(*Continued from page 93*)

When refinery oil furnaces were built in the form of a cubical brick box, containing horizontal heating tubes and a fire beneath, the bottom rows of tubes would overheat, as might be expected, from being subjected to radiant heat as well as heat absorbed by contact with hot gases. In a short time they would sag of their own weight, carbonize, and fail. The accepted answer was careful inspection and replacement of tubes and fuel combustion with wasteful excess of air. As the oil-refining industry began to expand, there began a period of design during which effort was made to hide tubes exposed to radiant heat behind brick walls for protection or to cover them with refractories. Still, failure continued to occur because some tubes were inevitably nearer the source of heat than others, and gravity exerted the same old pull.

Why not build a furnace with tubes symmetrically disposed around the source of heat, and why not hang them vertically so they could not sag? Why not be bold and put the major part of the heating surface in the radiant section to absorb and neutralize the radiant heat, instead of trying to dodge it or kill it with excess air? Why not indeed? This concept resulted in a vertical cylindrical-type furnace, with a tubular radiant section formed by lining the combustion chamber with tubes spaced symmetrically around its wall, with burners in the center delivering high-temperature heat either upshot or downshot. The radiant heat was then absorbed evenly. No tubes were overheated and all of them operated at the maximum allowable temperature. To complete the picture, an air heater was added to catch the residual heat from the flue gases, and put this waste heat into the combustion air, thus eliminating the costly and conventional economizer section. Again a new idea has worked so well that the oil heaters built for the Gulf Refining Company at Girard Point in 1928 are still operating efficiently. They served as a pattern for many others, likewise still in efficient operation, and now even prefabricated heaters of this type have become standard commercial refinery equipment.

Problems and situations such as these are constantly confronting the engineer. Design, layout, materials, and types of mechanism must be chosen with originality and ingenuity to be useful — not by following precedent. Unwillingness or fear to depart from the beaten track can often be traced to the quest for security. In seeking this elusive and lethargic state, there grows a tendency to entrench oneself in a job by resorting to overcaution, to become more and more conventional as a protection against mistakes, to resist progress for fear of its effect on one's existing status. When this occurs, we truly become slaves to our job, live in apprehension of what might happen to our employer, forego ambition, adventure, and even accomplishment to make retirement and pension the objective at which to aim.

If such a course produced real security it might have something to commend itself. As it is, trying to

(*Concluded on page 112*)

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THE ENGINEER AND SECURITY

(*Concluded from page 110*)

take a defensive position behind this sort of Maginot Line does not eliminate the hazards of life, for companies fail, managements change, products become obsolete, and inflation cuts our income. Nothing, good or bad, remains static. Change is the only normal state. The only real security lies in developing our ability and readiness to cope with the unexpected and with the unpredictable when it looms into reality, in moving ahead and not becoming discouraged when we falter, in protecting what we have by constantly striving for improvement.

In conclusion, let me point out that the engineer, by his very ability to create new wonders for human society, has acquired a responsibility which goes far beyond the practical application of technical knowledge. His mission in life must include giving consideration to the effect of technological advance on society and sharing in the task of helping people to assimilate the results of scientific progress. He must realize that, in his work, he must deal with human beings as well as with mechanisms and energy, that spiritual forces and human motivation are factors which can never be disregarded but must be reckoned with just as truly as steam pressure or electrical potential. Above all, he should never be dismayed or discouraged in this new world, largely of his own making, but venture on toward the limitless horizons which stretch before us. The road into the future is wide and untraveled.

WILLIAM T. SEDGWICK, BIOLOGIST

(*Continued from page 95*)

Drown, Head of the Chemistry Department at M.I.T. as advisers. In the following year, at Sedgwick's urging, M.I.T. created the first course in sanitary engineering in this country. The Institute was also the first to offer instruction in industrial hygiene, which was added to the curriculum in 1907.

In 1890 there descended upon the Merrimack Valley a terrible epidemic of typhoid fever, causing about 1,500 cases and many deaths in the cities of Lowell and Lawrence. From the Experiment Station, Sedgwick was called to the rescue and by the most skillful kind of sanitary sleuthing proceeded to locate the cause of the epidemic – pollution of a feeder of the river by the excreta of typhoid patients – and to demonstrate how to bring it under control. During this detective work Professor Sedgwick personally visited about 2,000 domiciles in the infected area, interrogating the agitated inhabitants and inspecting the premises. Two years later he traced another serious epidemic of typhoid in Springfield, Mass. to a totally unsuspected raw-milk supply. Sedgwick was one of the first to advocate the universal pasteurization of our market milk, a goal which even yet has not been fully achieved, although today about 85 per cent of all our milk is subjected to this most desirable heating process, and in the majority of the large cities it is 100 per cent pasteurized.

(*Continued on page 114*)

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***J. R. Vickery** '35*
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WILLIAM T. SEDGWICK, BIOLOGIST

(*Continued from page 112*)

In his classes in later years Professor Sedgwick liked to draw upon his experiences in these and other epidemics. To some of us these narratives seemed like digressions and wanderings, until suddenly we came to realize that they were extremely valuable lessons in human engineering and public relations, and that after all, public-health administrators must deal with people as well as with germs. The Chief, as he was affectionately known to his colleagues and graduates, seemed to have a very flexible system in his lectures, whose topics might be based on a newspaper clipping from the morning press or a recently published scientific article, or might be inspired by a naive question from a bewildered student. But whatever he talked about was worth listening to. It all built up to a liberal education, even in an engineering school.

Although he had a logical, orderly, and brilliant mind, Professor Sedgwick was indifferent about such vulgar and trivial matters as money, which was probably to his credit, and about such matters as the neatness and order of his office. His desk was frequently covered with reports, letters, pamphlets, books, and other objects, all apparently in complete disarray. Yet if he wanted to find something, such as a letter, he could always lay his hand instantly upon it.

Among his numerous extracurricular activities, Professor Sedgwick served as curator of the Lowell Institute, the lectures of which were given on afternoons and evenings in Huntington Hall. While the audience, consisting of students and the cultural elite of Boston, was arriving he would stand at the top of the staircase in the old Rogers Building, holding a venerable top hat over one arm as his invariable badge of office. He seemed to know everyone among the hundreds who customarily attended these lectures and greeted them all in his usual pleasant manner. It was not his function to select the speakers: These were chosen by the trustee and distant cousin of the founder, President A. Lawrence Lowell of Harvard. It was Sedgwick's duty, however, to minister to their social and professional needs, meeting their trains at any hour, housing them, dining and wining them, and providing all necessary facilities in a properly ventilated auditorium. He served in this office with extraordinary success for almost 25 years, until his death in 1921.

Many honors came to Professor Sedgwick and through him to the Institute. He was a director or trustee of numerous institutions, such as the Sharon Sanatorium, the Faulkner Hospital, and various others. He was president of a number of scientific societies, including the American Public Health Association (1914–1915), which subsequently established a Sedgwick Memorial Medal for distinguished service in public health, and the Society of American Bacteriologists. He was a member of numerous public and private organizations, such as the Massachusetts State Public Health Council and the International Health Board of the Rockefeller Foundation. In addition, he was in great demand as a speaker and writer.

Despite this crowded and extremely busy existence, Professor Sedgwick seemed always to have ample

(*Concluded on page 116*)

What GENERAL ELECTRIC People Are Saying

C. E. WILSON

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COST OF RESEARCH: It may seem to be a paradox that, at a time when science has so far progressed that its findings and its further directions are almost incomprehensible to ordinary men, it finds itself actually tied more tightly to ordinary men than ever before—first, because it has succeeded in almost scaring them to death with nuclear fission, and second, because the cost of research has gone right through the roof and must be paid for in large part out of the ordinary man's pants pockets.

Modern research has become enormously expensive. It must be supported by tremendous sums of money supplied by laymen, through direct or indirect taxation, even though those same laymen can in the very nature of things have little to say as to how that money is spent. A prime example of this is the development of atomic weapons, where decisions are taken by government as a matter of public policy, but often with the utmost secrecy. These decisions may cost the taxpayer his life; they may penalize him in his enjoyment of the normal fruits of progress; they are almost certain to cost him a lot of money.

As taxpayers and ordinary men, I don't think that any of us are quarreling with this state of affairs. I merely submit it to you—to those of you who are practicing scientists—as a sort of climatic condition which, like artificial rainfall, is new in this half of our century and therefore worthy of your consideration.

Research Laboratory Dedication
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October 9, 1950

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SHADOW MICROSCOPY: In an electron diffraction instrument, it is often desirable to view the specimen to determine its condition after evacuation of the system has taken place. Sometimes all or part of the sample material is removed during evacuation and no diffraction pattern can be obtained. At other times it may be that the supporting film is too thick or that the sample material is improperly dispersed on the film. Also, it is often desirable to locate the area from which diffraction is taking place.

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Electron Microscope Society of America
Detroit, Michigan
September 14, 1950

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E. E. PARKER

Apparatus Department

TURBINE DESIGN: During and following the war both the users and manufacturers of steam turbines for electric power generation in the United States have been continuously challenged by the rapid growth of the electric power load requiring a large increase of generating capacity.

Of the generating capacity currently being added, that provided by steam has comprised approximately 80 percent of the total. It might be assumed that such a condition would retard design progress in the interest of increased production. This is not the case, however, as the same period has been one of rapid progress in the development of the steam turbine and the entire steam plant. Notable advances have been made in the (1) development of much larger 3600-rpm units, (2) manufacture of turbines for initial temperature as high as 1050 F, (3) improved designs and extensive production of turbines for 950 and 1000 F initial temperature, and (4) wide application of the resuperheat cycle at today's pressure and temperature conditions.

The progress in development of steam-electric generating equipment has permitted continued reduction in the national average station heat rate, and is resulting in the construction of some new steam units with over-all heat rates below 10,000 Btu per kw-hr—the best with over-all thermal efficiency approaching 37 percent at the most favorable load.

General Electric Review
August, 1950

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F. M. BAILEY

Apparatus Department

AUTOMATIC CONTROL: The science of automatic control, given intense study during the war, has been applied with considerable success to many industrial control problems. The most powerful and at the same time most accurate servo-mechanisms still, however, are those used to supply the energy for moving naval turrets and open-deck guns.

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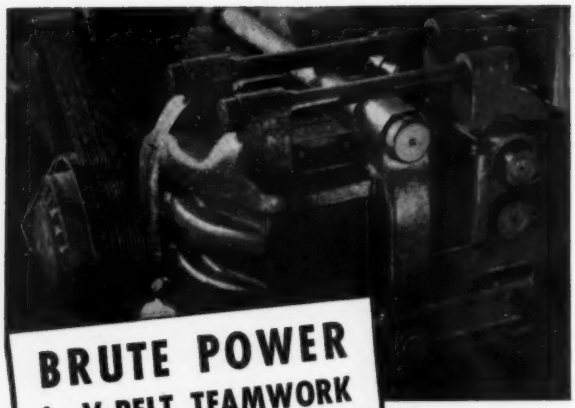

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WILLIAM T. SEDGWICK, BIOLOGIST

(*Concluded from page 114*)

time to devote to correspondence with, or visits from, his "boys," the many graduates of his Department – counseling, guiding, encouraging, and occasionally rebuking them. During World War I, he sent a form letter to all of us who were serving far from home in the armed forces, a letter which did much to promote morale and to remind us of the civilized things in life.

On January 24, 1921, I came to Cambridge from Washington, D.C., to give a lecture before Professor Sedgwick's classes. After this event I sat before his cluttered desk almost under the dome of the new buildings by the Charles River, and then accompanied him to lunch at a cafeteria on Massachusetts Avenue. He did not have much time that day, as he was faced with a long and exhausting meeting on the subject of a state university for the Commonwealth.

He did not have much time. Two days later I was shocked to read of his sudden death on January 25. His only survivor was his wife, Mary K. Sedgwick, to whom he had been ideally married for 39 years. He was succeeded as head of the Department of Biology and Public Health by Professor Samuel C. Prescott, '94, who had been his assistant and associate since 1894, and who later served also as dean of science at the Institute, a worthy disciple of a great leader. In The Review for April, 1921 (page 115) there appears an admirable sketch of the life and work of Sedgwick, written by Dr. Prescott. A more complete account of the life of this pioneer of public health appears in a book of similar title* by three of his most distinguished pupils: Edwin O. Jordan, '88, George C. Whipple, '89, and Charles-Edward A. Winslow, '98, issued by the Yale University Press in 1924.

In December, 1947, M.I.T. dedicated the William Thompson Sedgwick Laboratories of Sanitary Science in honor of his contributions to public health.

After all these years the story of Sedgwick, in part at least, is worth the retelling, for one of the most precious things in modern life is the noble tradition of the past. William T. Sedgwick was an unforgettable character not only because he was a pioneer in public health, but because of his charming personality, his wisdom and humor, the inspiration of his teaching, and his qualities as a true gentleman. "Men of courage, men of sense and men of letters are frequent," wrote Richard Steele in 1713, "but a true fine gentleman is what one seldom sees."

* *A Pioneer in Public Health: William Thompson Sedgwick.*

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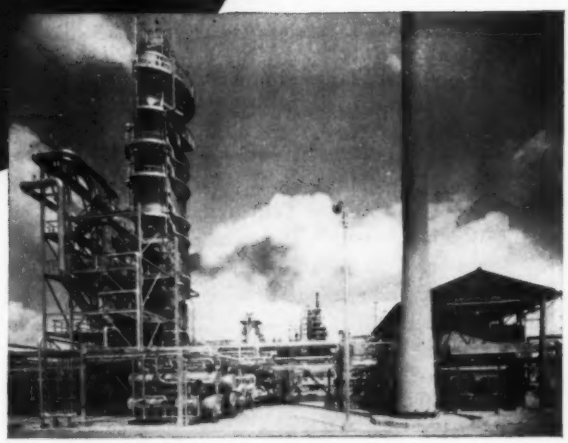

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THE INSTITUTE GAZETTE

(Continued from page 98)

ing to bring together our scattered and inadequately housed groups in electronics and nuclear science. We confidently hope that the remaining months of the Development Program will make this possible, along with a much needed Faculty Club.

The Development Program. The $20,000,000 Development Fund drive was carried beyond the $15,500,000 mark with the receipt of the grant of $1,500,000 from the Kresge Foundation late in June. This grant brings the additions to the Development Fund to around $10,000,000 since June of last year. Of the total amount of the fund to the present date, somewhat over one-third has come from corporations, another one-third from individuals, and the rest from foundations, estates, trusts, and other sources.

Three gifts of $1,000,000 or more highlighted this year's effort. The Campbell Soup Company grant of $1,000,000 for the biology and food technology laboratory and the $1,500,000 from the Kresge Foundation for an auditorium and chapel, made major contribution to our building program. An unrestricted gift of $1,000,000 was given to the Institute by John D. Rockefeller, Jr. This gift will be used for continuing operating needs, in accordance with the preference expressed by Mr. Rockefeller and our own objective of bolstering the Institute's unrestricted funds. In making this gift, Mr. Rockefeller stated that he did so in the hope and the belief "that the Institute may continue to expand its strategic service to all interested in the advancement of science for the betterment of mankind, irrespective of national boundaries."

Some 200 corporations have contributed to the Development Program to date, and the number is steadily increasing. Almost one-fourth of these companies are making grants spread over a period of years under the Industrial Liaison Program through which the Institute renders the companies a variety of special services. The growth in number of these co-operative arrangements with larger companies is heartening endorsement by industry of the pattern of co-operation which M.I.T. is developing.

Impressive and promising is the fact that 40 per cent of all the cash gifts received by the Institute during the past year came from corporations.

The untiring efforts of Marshall B. Dalton, '15, as chairman of the M.I.T. Development Fund have contributed mightily to its successful year, as have the interest and support of Mr. Sloan, the honorary chairman. I find it difficult to pay adequate tribute to the M.I.T. Alumni throughout the country who have given unsparingly of their time, their ability, and their effort. This spring more than 200 members of the Committee on Financing Development attended a meeting at the Institute, the third national meeting since the drive began. The interest of the M.I.T. Alumni in the Development Program, as indicated in extraordinary measure by this group, gives us reason to expect that the current year will bring the $20,000,000 drive to a successful conclusion.

Special needs and opportunities at M.I.T. were brought to the attention of the Corporation when Dr. Killian mentioned the inadequacy of funds for scholarships, for the development of the Round Hill estate, and for the support of the humanities and social sciences. Speaking of these needs in that order, he said:

Scholarships. The objectives of the Development Program include many of the current major needs of the Institute, but not all. One serious omission is adequate

(Continued on page 120)

A Report
TO M.I.T. MEN

In 1917 Walker Memorial Building was opened, a gift from Alumni for the welfare of M.I.T. students. In addition to including offices for student activities and serving as a student social center, this building houses the dining service.

In 1949–50 nearly one million meals were served to staff and students and 57 dances, receptions and balls were held in Morss Hall. Morss Hall seats approximately 500 people. Thus, each chair served 2,000 people per year or 5.5 persons per day. We thank the Alumni for making these services possible.

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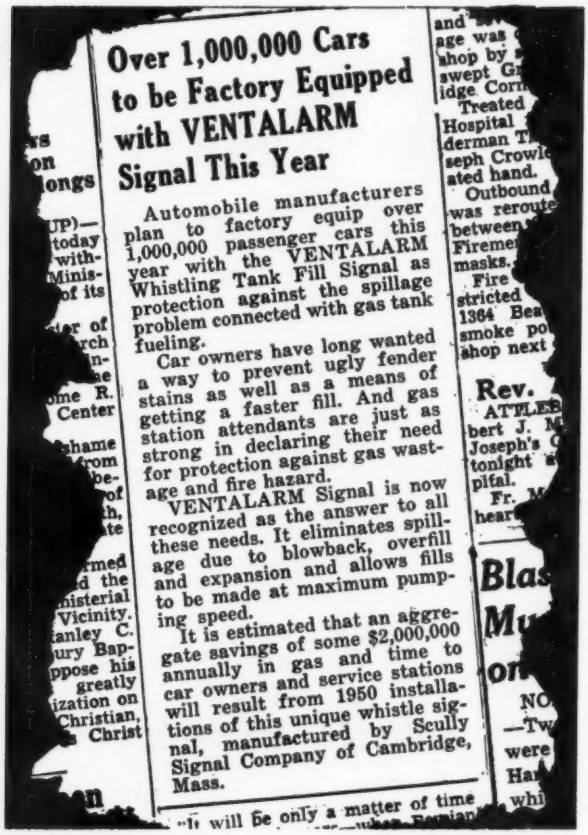

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...It will be only a matter of time

THE INSTITUTE GAZETTE

(*Continued from page 118*)

scholarship funds. Last year our undergraduate scholarship awards totaled only $188,096, or $53 per undergraduate. Of the total undergraduates enrolled, 602 received scholarship assistance, and the average award was $312.

At another institution which draws a student body with a national spread comparable to ours, but which has a lower tuition, the undergraduate scholarship awards averaged $100 per student enrolled. Many other institutions are similarly higher in their awards than our own.

The evidence is clear that many applicants of outstanding merit but of inadequate financial means turn away from the Institute, their first choice, to other colleges where more adequate scholarship aid is available to them. . . .

The Executive Committee has earmarked for scholarships the income of $500,000 received for the Development Program as a first step in building up our funds. A major objective in the months and years ahead must be the further increase of our undergraduate scholarship funds: For this purpose we need at least to double our present endowment of $3,400,000. In stressing the need for undergraduate scholarship funds, I do not infer that we do not at the same time need additional graduate scholarship funds. We do, but our graduate scholarships are more nearly ample than our undergraduate . . .

Round Hill. Last year I spoke of our opportunity to make effective use of Round Hill, the estate near New Bedford, Mass., given the Institute by Mrs. Matthew Astor Wilks, provided we could obtain funds to recondition the large stone mansion on the property and to endow its operation. We are still seeking funds for this purpose, since we envisage many important uses for the estate . . .

Humanities and Social Sciences. I have mentioned plans to strengthen our educational work in these fields. Again an

(*Concluded on page 122*)

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THE INSTITUTE GAZETTE

(Concluded from page 120)

important step ahead depends upon obtaining the necessary funds, and support is not so readily obtainable for the humanities as it is for technology and science. Corporations, for example, do not feel that they can properly contribute to the humanities. I hope that the concept of the "Fourth School" as adopted by our Faculty and the important fields embracing the social sciences can attract the support which will enable us to exploit this part of our program. We need an endowment, including endowed professorships, of at least $2,000,000 to fund essential activities in these fields.

I cite these special needs, not included in our Development Program, because they are not so obvious and not because they necessarily have top priority. The department heads of the Schools of Science and Engineering have well demonstrated needs for new equipment, space, and programs running into many hundreds of thousands of dollars and which we must and will provide. Our new program in geology is an example. . . .

President Killian's annual report included statistics on the financial operations for the year 1949–1950 (summarized in the Treasurer's Report on page 100 in this issue), recorded personnel changes, the most important of which have been published in The Review during the last year, and was concluded with a tribute to his colleagues as follows:

In conclusion, I want to emphasize the major contribution to the administration of the Institute being made by Julius A. Stratton, '23, our Provost. He has a sound and deep understanding of education and a sure administrative touch. So likewise have the deans, who, together with the provost and the chairman of the Faculty, make our Academic Council an effective instrument.

The event of the year was the return full time to the Institute of Karl T. Compton, chairman of the M. I. T. Corporation, following his happy triumph over illness. I can testify to the reassurance we all feel now that we again have the uninterrupted benefit of his vigor and leadership.

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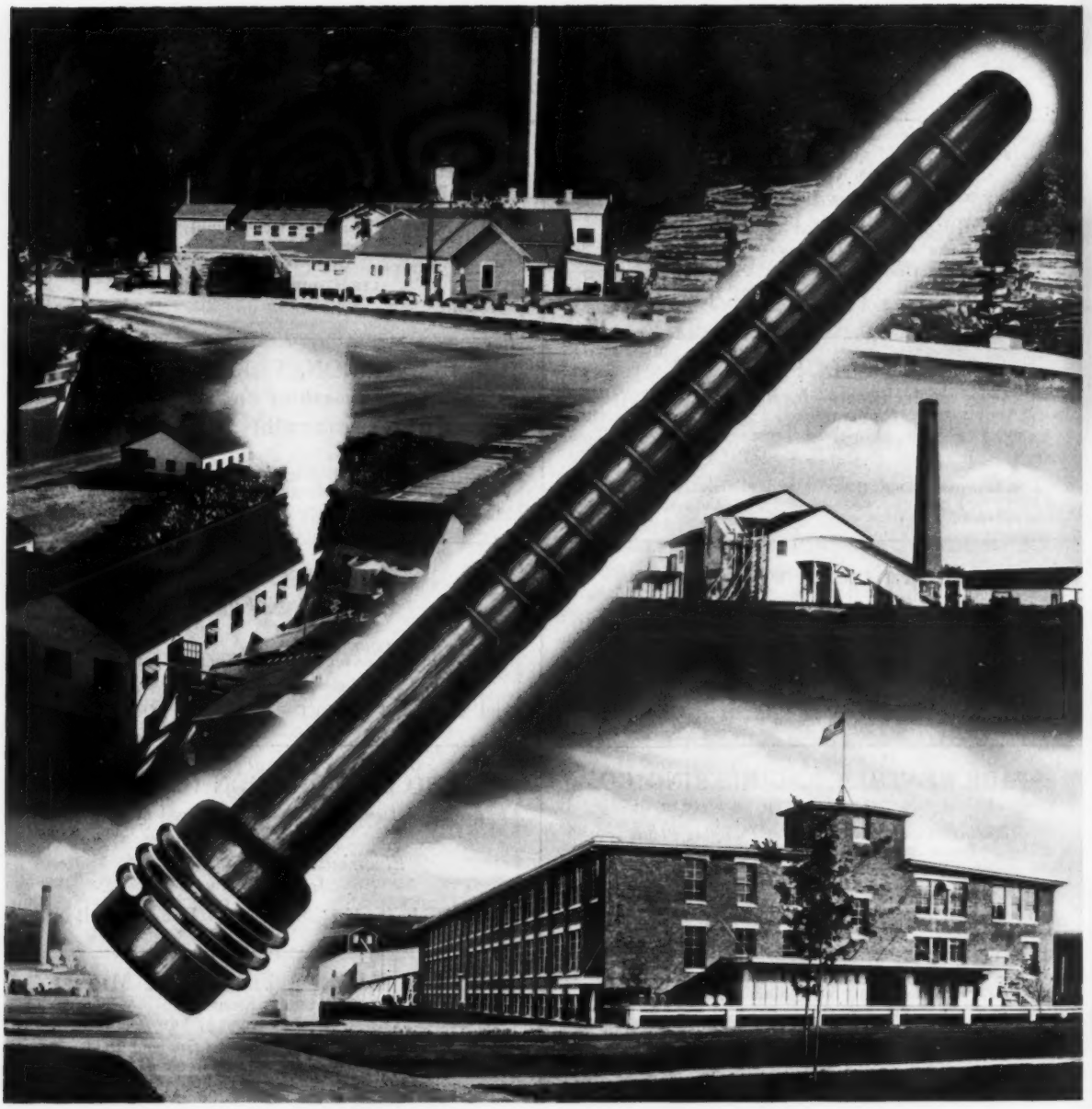

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